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PACIFIC COAST HYDROELECTRIC DEVELOPMENT.
BY JOHN HARISBERGER.

FIRE PROTECTION OF ELECTRIC PLANTS.
BY M. E. CHENEY.

FEASIBILITY OF ELECTROCHEMISTRY AT THE DALLES.
BY O. F. STAFFORD.

SALIENT FEATURES OF N. E. L. A. PAPERS.

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Alphabetical Index to Advertisers, Page 8 | Where to Buy It in the West, Page 9

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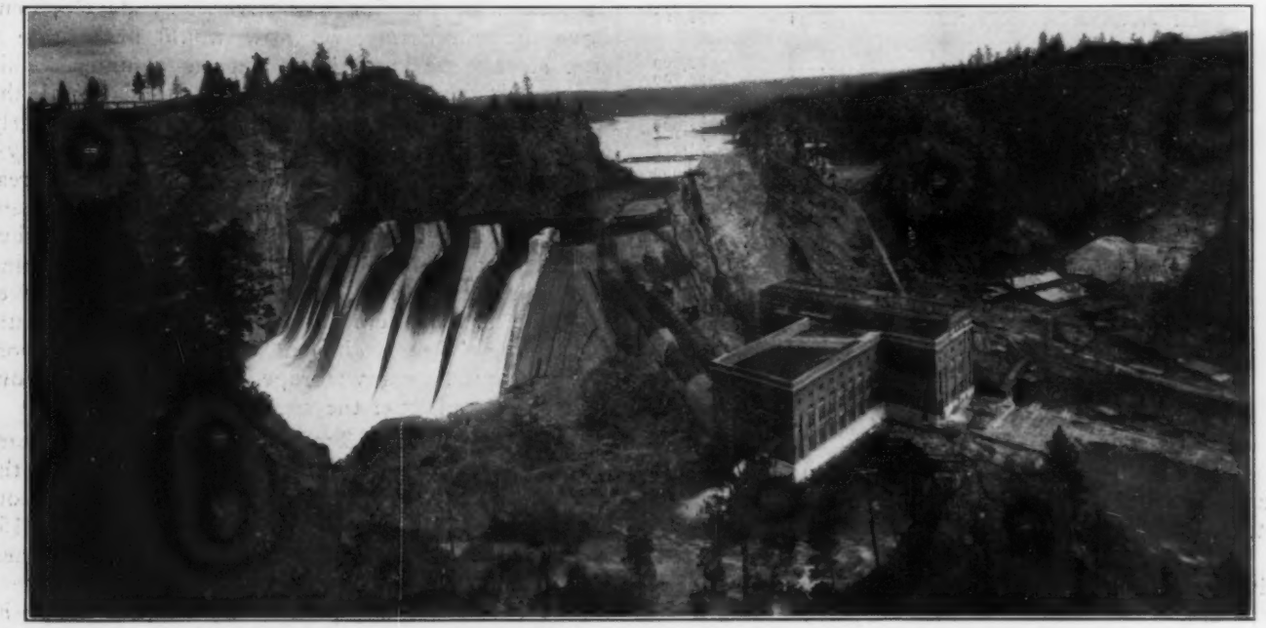
PACIFIC COAST HYDROELECTRIC DEVELOPMENT

BY JOHN HARISBERGER.

(This comprehensive summary of typical operating conditions is slightly condensed from a paper presented at the 39th convention of the National Electric Light Association, Chicago, May 22-26, 1916. The author is superintendent of water power Puget Sound Traction, Light & Power Co., Seattle.—The Editor.)

The Pacific States are conservatively estimated to possess eight million kilowatts of kinetic energy in the form of flowing water available the year around, and if efficient storage methods were to be utilized the power output could be increased five times, making an ultimate output of forty million kilowatts. However there are but three plants of the one hundred and sixty-eight now operating on the coast, where there is sufficient water to carry the rated load 365 days in the year and utilize the greatest part of the annual river flow. This is due to the excessive cost involved in providing a storage basin that will conserve the flood waters and to the fact that a very small percentage of the available energy is needed to supply the demand for power at present. It has been much more economical to install a number of small plants utilizing the minimum river flow than to intensively develop a few large installations with a view to conserving the total energy in the river.

Electrical development in Washington, Oregon and California at present totals about 800,000 kilowatts with a one-hour peak capacity of 900,000 kilowatts and with hydraulic development sufficient to give about a million kilowatts by simply adding the necessary generating units. The demand for electric power has not increased at the rate that was estimated four or five years ago, and as a result of the depressed business conditions of the past few years, most of the systems have now a large surplus of power electrically developed and an additional 25 per cent hydraulically developed. For example, one plant in eastern Washington is now completed and lies inoperative for want of load, awaiting the coming of industries which will absorb its output. Under such conditions the price of electricity on the coast is the lowest anywhere in the United States, being supplied at $30 per h.p.-year to loads as small as 100 h.p. and coming close to $12 per h.p.-year for large quantities on a wholesale basis



Washington Water Power Company's Long Lake Plant.

These figures are dangerously close to the cost of production and it is the exceptional utility which has yielded more than 3 or 4 per cent on the investment during the last five years. However, a resumption of prosperous business conditions in the West and the electrification of the transcontinental railroads will quickly absorb the present surplus and make necessary the further development of available water power; and particularly is this true in Washington, which state

Hydroelectric Development on the Pacific Coast.

	Plants.	Hydroelectric Capacity. kw.
British Columbia—		
British Columbia Electric Railway Co., Ltd..	3	60,000
Western Canada Power Co. Ltd.....	1	36,000
West Kootenay Power & Light Co., Ltd....	2	9,000
Bull River Electric Power Co., Ltd.....	1	9,000
Miscellaneous small plants.....	5	1,000
Total	12	115,000
Washington—		
Puget Sound Traction, Light & Power Co..	4	55,000
Washington Water Power Co.....	3	41,000
Not operating at present.....	1	38,000
Tacoma Municipal Plant.....	1	20,000
Pacific Power & Light Co.....	10	14,000
Seattle Municipal Plant.....	2	15,000
Olympic Power Co.....	1	6,000
Wenatchee Gas & Electric Co.....	1	3,000
Miscellaneous small plants.....	25	8,000
Total	48	200,000
Oregon—		
Portland Railway, Light & Power Co.....	4	43,000
California-Oregon Power Co.....	7	62,000
Northwest Electric Co.....	1	13,000
Eastern Oregon Light & Power Co.....	5	4,000
Hanford Irrigation & Power Co.....	1	1,600
Eugene Municipal Plant.....	1	1,400
Miscellaneous small plants.....	25	10,000
Total	44	135,000
California—		
Pacific Gas & Electric Co.....	11	82,000
Pacific Light & Power Co.....	6	80,000
Great Western Power Co.....	1	50,000
Northern California Power Co.....	7	37,000
Sierra & San Francisco Power Co.....	3	34,000
Southern California Edison Co.....	5	27,000
San Joaquin Light & Power Co.....	4	25,000
Los Angeles Municipal Plant.....	1	22,000
Southern Sierras Power Co.....	5	19,000
Arrowhead Reservoir & Power Co.....	1	15,000
Mt. Whitney Power & Electric Co.....	4	6,000
Snow Mountain Water & Power Co.....	1	6,000
Pacific Power Co.....	1	3,000
Oroville Electric Corporation.....	1	3,000
Western States Gas & Electric Co.....	1	3,000
Holton Power Co.....	2	1,000
Ontario Power Co.....	1	1,000
Yosemite Power Co.....	1	1,000
Miscellaneous smaller plants.....	20	5,000
Total	76	420,000
Grand total, British Columbia, Washington, Oregon and California.....	180	886,000
Total Washington, Oregon and California.	168	755,000

has more available hydraulic energy than any other in the Union and about one-fifth of the total in the United States.

With the undeveloped water powers now indefinitely tied up in litigation and controversies between federal and state governments, and with various regulatory bills now pending in congress, we face the problem of intensifying our present developments and of making our future projects the most efficient possible. It is possibly true also that the most readily accessible water sites and those offering the cheapest development have all been utilized, and most of the remaining projects will require enormous capital to put the energy on the market. These conditions bring to our attention the generation of electricity by other prime movers than hydro-motors and to the improvement of efficiency in our present plants, and it seems appropriate to discuss at this time the general characteristics of the systems operating on the Pacific Coast, the distribution of load among the several plants in a system and the manipulation of storage facilities.

Northwestern Companies.

The Washington Water Power Company of Spokane, operates three plants on the Spokane River; Post Falls, Spokane City and Little Falls. The system extends in and about Spokane, a city of 100,000 population, east to Lake Pend O'reille, west to Harline and south to Colfax, some 300 miles of transmission lines. The power is generated about the center of the system and fed out over radial lines to the consumers. The energy is supplied to farmers and farming communities, irrigation pumps, cement mills, city and interurban railways and for commercial light and power. Apples, peaches and other fruits are grown extensively to the east of Spokane and require irrigation, while to the west and south wheat is the leading crop and is raised on dry land. The principal market is the farming country and this of course makes long transmission necessary with relatively few customers per mile, but it is mostly continuous and off-peak power. Added to this outside load is the city light and power load and the railway, which have the usual characteristics. This makes up to a total load with the unusually high daily load-factor of 85 per cent, and necessitates only small pondage facilities, which condition obtains. Coincident with low water, the summer load falls to 75 per cent of the winter load, requiring a river flow of nearly constant amount. This not being the case with the Spokane River, any development above the minimum river flow would necessitate a large storage basin to draw on in summer. This company is developing such a plant. In general, the Post Falls plant carries a continuous load with nearly 100 per cent load factor and the regulation of the system is carried on the Little Falls plant, which by reason of more modern machinery is the most convenient method. The Spokane plant is small and carries but a small part of the load. A 14,000 kw. coal burning steam plant is held as emergency reserve, but never has to be used. There is no effort made to distribute load among the most efficient units first, nor is it possible to manipulate any storage. The pondage is about sufficient to pull over the small peak.

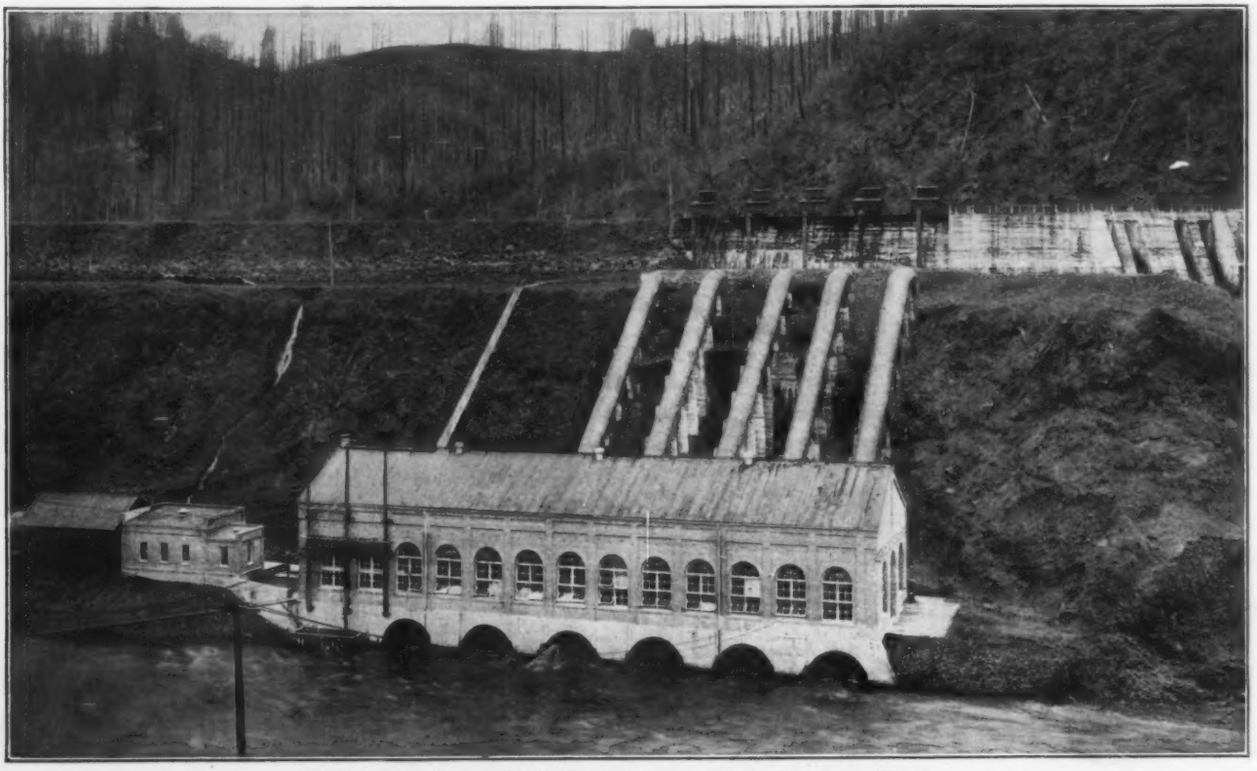
The Puget Sound Traction, Light & Power Company operates one of the representative systems of the Northwest, extending from Tacoma, Washington, north to the Canadian boundary, a distance of 150 miles and including a network of transmission lines. Five hydroelectric stations on five different rivers feed the system at as many points, viz: Electron from the south, Snoqualmie from the east, White River at the "center of gravity," Nooksack from the northeast, and Stave Lake from the north. Stave Lake plant is in Canada and is operated by the Western Canada Power Company, which sells power to the Puget Sound Traction, Light & Power Company at the Canadian boundary and also carries a large load in and about Vancouver, B. C. It will be noted that in the Puget Sound Traction, Light & Power Company system the generating plants are all except one located on the outskirts of the system and feed in toward the center, whereas with the Washington Water Power Company the converse is true.

The market for power and the nature of the load are very different on Puget Sound and the average

load factor is 65 per cent as against 85 per cent in the eastern part of the state. The bulk of the people live in small towns and the cities of Seattle and Tacoma, and the chief business of the central station is to supply their demands in these places. The lumber industry leads in value of products, but as yet the use of electricity in logging and in transporting logs from the forests to the mill is only an experiment, steam power being used for this work. The cost of the wood fuel is little or nothing. The best lumber mills are driven by individual electric motors, but the power can be supplied from the mill's own steam plant far cheaper than a hydroelectric company can sell it, for the fuel not only costs nothing, but it is an asset to have this means of disposing of the waste lumber and sawdust. These factors have eliminated the lumber business from the central station market, but arrangements have just been made to supply certain of the large mills with central station service during such periods as there is an excess of water available; the mill to maintain its own steam plant ready for operation on 48 hours' notice. Transportation and commerce are also driven by steam power, although the near future bids fair to bring the railroads into the electrical market. This leaves only the possibility of furnishing power to small miscellaneous manufacturing, city and interurban railroads and commercial activities, all of which are in operation during the daytime and evening and are off between midnight and morning.

Mt. Rainier from Electric Flume of Puget Sound Traction, Light & Power Company.

The characteristics of such a load are a high morning peak about 8 o'clock, a small drop at noon and then the highest peak at 6 p. m., with the load falling off rapidly until midnight and a very small load until 6 a. m. To answer such requirements, the hydroelectric system has a large installed machine capacity with pondage facilities which through the dry season store sufficient water during the night to carry the peak loads. A further refinement was made in developing the White River plant to carry a continuous load of 24,000 kw. by using the large storage in Lake Tapps and operating the other plants only during the peak periods. A central load dispatcher supervises the operation of all plants, and distributes the load as it develops. Only when water is very scarce is any effort



Portland, Railway, Light & Power Company's Cazadero Plant.

SYSTEM DATA.

System.	Location.	Nature of Load.	Transmission Voltage.	Average Transmission Line Loss.	Rated System Capacity 24 hr. Day, kw.	Peak System Capacity 1 hr. per Day, kw.	Av. 24 hr. Daily Load in Annual Peak Period, kw.	Av. 24 hr. Daily Load in Annual Minimum Period, kw.	Daily Peak in Annual Peak Period, kw.	Daily Duration of Peak.
Pacific Gas & El. Co.....	No. Central California.	General L. & P.	110000 60000 24000 17000	17.8%	170200	206500	87500	82500	130000	5:30 p.m. to 7:00 p.m.
Pacific L. & P. Corp.....	Southern California.	1/3 Com'l. L. & P. 2/3 City & Sub. Ry.	150000 60000 50000 15000	20%	110000	.....	35900	.....	.....	
So. Cal. Edison Co.....	Los Angeles and So. California.	General L. & P.	66000 33000 10000	15%	86150	90000	40000	32000	52000	5:30 p.m. to 8:00 p.m.
Puget Sound Traction.... Light & Power Co....	Tacoma to Bellingham, Wash.	Com'l & Res. L. & P. Mfg., Mines & Mills, Street Rys.	55000 13800 6600	10%	60000	85000	42800	30400	66000	5:00 p.m. to 6:00 p.m.
Great Western Pr. Co....	Central California.	General Power & Lighting.	100000	10%	70000	80000	40948	35644	62100	5:30 p.m. to 6:00 p.m.
Portland R., L. & P. Co...	Portland, Ore., and vicinity.	Com'l L. & P. & City & Suburb Railway.	60000 57100 33000 11000	8%	58380	72520	24500	19300	38300	5:00 p.m. to 6:00 p.m.
Wash. Water Power Co...	Spokane and vicinity, Washington.	Com'l L. & P. St. Ry., Mining.	60000	10%	54550	68187	24200	18000	28691	5-6 p.m.
San Joaquin L. & P. Co...	California.	Com. & Ind. Pr. Ry. & Ltg.	60000 30000	16.72%	43980	48600	13800	10000	19800	8-8:30 p.m.
Western Canada P. Co....	In and around Vancouver, B. C., and S. to Blaine, Wash.	Com'l L. & P., Res., City & Int. Rys.	60000	....	36000	50000	.....	.....	....	
So. Sierras P. Co.....	Nevada and California	Mining. Mfg. Irrigation.	55000 now 110000 ult.	16%	16800	21300	18000	15500	....	9 a.m. to 11:00 a.m.

PLANT DATA.

Plant.	Location.	Name of River.	Approx. Length of River-Source to Intake, Miles.	Nature of Source.	Drainage Area, Sq. Miles.	Capacity, Acre Feet.	Av. Length, Miles.	Av. Width, Miles.	Kw.-hr. per Ac. Ft.	Kw. per Sc. Ft.
Pacific Gas & El. Co.....										
Alta	1 California Placer County. T 16 N, R 10 E, Sc 25.	Boardman Canal.	40	Natural	121	None	....	....	....	20
Centerville	On Butte Creek Sec 5, T 22 N, R 3 E.	Butte Creek.	25	Springs	61	See de Sabla.	....	....	....	40
Colgate	Yuba County. Sec 16. T 17 N, R 7 E.	Yuba River. Lake Francis.	40	Springs So. Yuba	483	.....	....	....	....	40
Deer Creek.....	Nevada County. Sec 34, T 17 N, R 10 E.	Chalk Bluff. Canal.	40	Watershed	121	1.72	....	....	....	40
de Sabla	Butte County. Sec 10, T 23 N, R 3 E.	Butte Crk., Feather R.	18	Lakes & Springs	108	St. 878 Pd. 252	....	....	....	85
Drum	Placer County. Sec. 17, T 16 N, R 11 E.	Lk. Spaulding, So Yuba	40	Lake.	121	425	....	....	....	80
Electra	Amador County. Sec 32, T 6 N, R 12 E.	Mokelumne.	45	Lakes & Springs	332	117	....	....	....	55
Folsom	Sacramento County. T 10 N, R 7 E.	American.	55	Springs, Watershed	...	None	....	....	....	3
Halsey	Clipper Gap. Placer County.	So. Yuba Water Sys.	40	So. Yuba Watershed	121	150	....	....	....	20
Newcastle	Placer County. Sec 30 T 12 N, R 8 E.	Boardman Canal.	40	So. Yuba Water Sys.	121	None	....	....	....	3
Wise	Auburn, Placer County.	So. Yuba Water Sys.	40	So. Yuba Water Sys.	121	376	....	....	....	30
Oakland	Oakland.	Steam.								
Sacramento	Sacramento.	Steam.								
San Jose	San Jose.	Steam.								
San Francisco.....	San Francisco.	Steam.								
P. L. & P. Corp.										
Sierra	35 mi. E of Los Angeles.	San Antonio Creek.	5.75	Natural Drainage	18	None	....	....	....	34
Mentone	70 mi. E of Los Ang.	Santa Anna.	15	Natural Drainage	182	None	....	....	....	18
Borel	120 mi. N. of Los Ang.	Kern.	78	Natural Drainage	1220	None	....	....	....	13.8
Azusa	20 mi. E of Los Ang.	San Gabriel.	25	Natural Drainage	222	None	....	....	....	17.5
Big Creek No. 1.....	45 mi. N E of Fresno.	Big Creek.	14	Natural Drainage	88	51500	4	0.43	1623	130
Big Creek No. 2.....	45 mi. N E of Fresno.	Big Creek.	16	Natural Drainage	113	1053	....	....	1490	121
Redondo	Redondo.	Pittman Creek. Steam.	7							

Daily Peak in Annual Minimum Period, kw.	Daily Duration of Peak.	Annual Peak Period.	Annual Minimum Period.	Annual Low Water Period.	Low Water Seasonal or Annual?	Is Load Distributed by Load Dispatcher?	Is Gen. Sta. Nearest to "Center of Gravity" of System kept Loaded?	Are Most Efficient Units Loaded First?	Is the System Regulation Carried on Steam or Hydro?	Are Steam Plants at Center of Load?	Use of Steam Plants.	Do Steam Plants Make up kw.-hr. or kw.?	Average Daily Load Factor.
118000	6:00 p.m. to 7:00 p.m.	Sept. to Nov. Incl.	Jan. to Mar. Incl.	Oct. to Dec. Incl.	Annual	Yes	Yes	Yes	Hydro	Center of Load	Emergency Stand by and Low Water		65%
						Yes				Near Water			50%
46000	5:30 p.m. to 8:00 p.m.	Sept. 1 to Jan. 1 Evening	Jan. 1 to June 1 Evening	Aug. 15 to Jan. 15	Annual	Yes	No	Yes	Steam	Near Water	One Plant entire year. Two Plants Stand by	Kw-hr.	75%
43000	5:00 p.m. to 6:00 p.m.	Dec. 15 to Dec. 31	Apr. 15 to Apr. 30	Aug. 15 to Sept. 15	Annual	Yes	No	Yes	Hydro	Center of Load	Stand by only Emergency	Peak kw.	65%
53000	8:30 p.m. to 9:00 p.m.	Oct. to Dec. Incl.	Jan. to March Incl.	July to Dec. Incl.	Annual	Yes	No	Yes	Hydro	Center of Load	Emergency Stand by	Peak kw.	65%
27700	5:00 p.m. to 6:00 p.m.	Dec. 15 to Jan. 15	Aug. 1 to Sept. 1	July 15 to Oct. 1	Annual	Yes	No	Yes	Hydro	Center of Load	Emergency Stand by Low Water	Peak kw.	65%
23879	10:30 to 11:30 a.m. 7:30-8 p.m.	Dec. to Feb.	July to Sept.	Aug. to Nov.	Annual	Yes	No	No	Hydro	Center of Load	Emergency		85%
16000	6 to 6:30 p.m. or 9 to 10 a.m,	July to Oct.	Dec. to Feb.	Aug. to Nov.	Annual	Yes	No	No	Hydro	Center of Load	Emergency Standby and Low Water		65%
				Mar. 1 to Mar. 31	Annual	No							
	9 a.m. to 11 a.m.	May to Sept. Incl	Oct to Apr. Incl.	Oct. to Mar. Incl.	Annual	No	No	No Choice	High Water by Hydro Low Water by Steam	Center of Load	Emergency and Low Water		75%

	Max. Head, Feet.	Minimum Head Feet.	Effect of Variation in Head.	Generating Voltage.	Transmission Volts Out of Plant.	Rated Plant Capacity, 24-hr. kw.	Peak Plant Cacacity, 1 hr., kw.	Sufficient Water to Operate Plant, Rated Load Throughout the year?	Is it Necessary to Draw on Storage to do This?	Pondage—Daily hrs. of Draw Out.	Pondage—Daily hrs. of Fill Up.	Steam Plant Type of Prime Mover.	Fuel.
Alta	660	660	None	500	60000 22000	2000	2000	No		8:00 to 11:00 a.m. 2:00 to 5:00 p.m.			
Centerville	577	577	None	2300	60000	6400	6400	No		8:00 to 11:00 a.m. 1:00 to 5:00 p.m.			
Colgate	700	700	None	2300	60000 30000	10700	13000	No		8:00 to 11:00 a.m. 2:00 to 5:00 p.m.			
Deer Creek	837	837	None	2300	60000	4000	5000	No		8:00 a.m. to 1:00 p.m. 2:00 to 5:00 p.m.			
de Sabla	1531	1531	None	2300	60000	12300	12500	No		8:00 to 11:00 a.m 1:00 to 5:00 p.m.			
Drum	1375	1375	None	6600	110000	16000	25000	No					
Electra	1467	1267	None	2300	60000 17000	10800	17000	No					
Folsom	55	26	None	800	60000	3750	3750	No					
Halsey	340	315	None	6600	110000 60000	9000	12500	No					
Newcastle	464	464	None	500	60000	570	900	No					
Wise	519	499	None	6600	60000	6500	12500	No					
					Oakland	14000	18000						
					Sacramento	5000	6500						
					San Jose		2500						
					San Francisco	34000	45000						
Sierra	628	....	.....	500	15000	....	650	No					
Mentone	352	...	.....	2200	15000	....	1550	No					
Borel	262	...	.....	2200	50000	....	10000	No					
Azusa	400	...	.....	500	150000	.....	1625	No					
					Redondo	40000							
Big Ck. 1	2009	1924	None	6600	150000	....	32000	Yes	Yes				
Big Ck. 2	1815	1796	None	6600	150000	....	32000	Yes	Yes				

Curtis Turbine	Oil
Parsons Turbine	Oil
Recip.	Lamp Black
Curtis Trb. & Eng.	Oil
Redondo, Curtis Trb. Recip.	Oil

PLANT DATA—Continued.

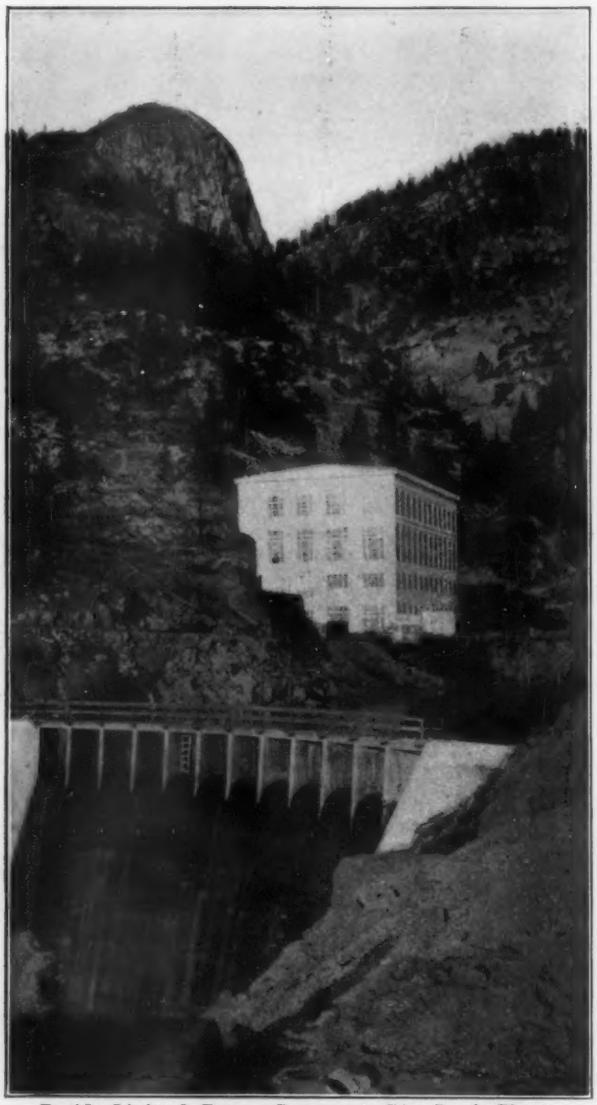
Plant.	Location.	Name of River.	Approx. Length of River-Source to Miles Intake.	Nature of Source.	Drainage Area, Sq. Miles.	Capacity, Acre Feet.	Av. Length, Miles.	Av. Width, Miles.	Kw.-hr. per Ac. Ft.	Kw. per Sc. Ft.
So. California Edison Co.										
Kern River No. 1....	Kern County. Sec. 29, T 28 S, R 20 E.	Kern.		Lakes and Springs	2330	Not Avail. 92	....	....	....	56
Mill Creek No. 1....	San Bernardino County. Sec. 14, T 15 S, R 2 W.	Mill Creek.	35	Springs and Snow	45	7	....	....	....	30
Mill Creek No. 3....	San Bernardino County. Sec 12, T 1 S, R 2 W.	Mill Creek.	30	Springs and Snow	19	7	....	....	....	126.5
Santa Anna No. 1....	San Bernardino County. Sec. 26, T 1 N, R 2 W.	Santa Anna.				Controlled by				
Santa Anna No. 2....	San Bernardino County. Sec 34, T 1 N, R 2 W.	Santa Anna.	30 35	Bear Lk. Reservoir Bear Lake	180 159	Water Co. ditto	....	....	....	41.0 19.5
Long Beach	Long Beach.	Steam.								
Los Angeles No. 3...	Los Angeles.	Steam.								
P. S. T., L. & P. Co., Seattle Division.										
White River.....	Sec 7, T 20 N, R 5 E, WM.	White.	40	Glaciers	424	36800	....	....	326	27
Snoqualmie	Secs 19 and 30, T 24 N. WM.	Snoqualmie.	40	Lakes and Springs	400	450	2.46	0.047	172	14.2
Electron	Sec. 33, T 18 N, R 5 E, WM.	Puyallup & Mowich.	12	Glaciers	90	88	....	....	562	46.5
Georgetown	Seattle.	Steam.								
Post Street	Seattle.	Steam.								
Bond St., Everett....	Everett.	Steam.								
Nooksack	Nooksack Falls.	Nooksack.		Glaciers	...	....	....			
York St.	Bellingham.	Steam.								
Purchased	Blaine.	Hydro.								
Great Western P. Co., California.										
Big Bend	Las Plumas. Butte County, Cal.	No. Fk. Feather River.	50	Springs	1940	240000	7.5	4	225	27
Oakland S. P.....	Oakland.	Steam.								
San Francisco.....	San Francisco.	Steam.								
Portland Ry., Lt. & Pr.										
River Mill	Near Estacada, Ore.	Clackamas.	55	Spring	685	1215	2.5	0.045	54.45	4.5
Oregon City.....	Oregon City.	Willamette.	150	Springs	10200	600	3	0.11	Variable	
Cazadero	Cazadero.	Clackamas.	50	Spring	685	688	0.5	0.19	72.6	6.0
Bull Run	Bull Run.	Big Sandy.	19	Glacier	....	2964	.75	0.38	187.55	15.5
North Portland.....	Portland.	Steam.								
East Portland	Portland.	Steam.								
St. Johns		Steam.								
Salem	Salem, Ore.	Steam.								
Washington W. P. Co.										
Post Falls	Post Falls, Idaho.	Spokane.	9	Lake	3662	161150	30	1.5	42.5	3.5
Spokane Pr. St.....	Spokane.	Spokane.	36	Lake	4043	None	....	....	34.2	3.1
Little Falls.....	15 mi. N. of Reardon.	Spokane.	72	Lake	5903	1740	4	.75	55	4.6
San Joaquin L. & P.										
San Joaquin No. 1...	S 18, T 9 S, R 23, E, Cal.	No. Fork San Joaquin.	19	Creeks	95	51000	2	0.25	1080	90
San Joaquin No. 3...	S 12, T 8 S, R 22 E, Cal.	No. Fork San Joaquin.	16	Creeks	78	51000	2	0.25	324	27
Tule	S 26, T 20 S, R 30 E, Cal.	Tule.	9	Creeks	34	None	....	....	1120	93.5
Kern Canyon.....	S 6, T 29 S, R 30 E, Cal.	Kern.	100	Lakes and Springs	7	None	....	....	156	13
Bakersfield	Bakersfield.	Steam.								
Fresno	Fresno.	Steam.								
Santa Maria	Santa Maria.	Steam.								
San Luis Obispo.....	San Luis Obispo.	Steam.								
Western Canada P. Co..										
Stave Lake	35 mi. E of Vancouver.	Stave.	7	Glaciers	450	360000	9	1.5	....	....
Southern Sierras P. Co.						Hillside Res.				
No. 2 Nev.-Cal. P. Co.	Sec. 9, T 8 S, R 31 E, MDM.	Bishop Creek.	5	Lakes	38.3	13100	1.75	0.3	....	33
No. 3 Nev.-Cal. P. Co.	Sec 36, T 7 S, R 31 E, MDM.	Bishop.	7	Lakes	38.3	No. 1 Res. 8000 Ditto	1.0	0.5	....	 45
No. 4 Nev.-Cal. P. Co.	Sec 19, T 7 N, R 32 E, MDM.	Bishop.	9	Lakes	38.3	Ditto	....	....	....	58
No. 5 So. S. P. Co..	Sec. 17, T 7 S, R 32 E, MDM.	Bishop.	11	Lakes	38.3	Ditto	....	....	....	21
No. 6 So. S. P. Co..	Sec 9, T 7 S, R 32 E, MDM.	Bishop.	31	Lakes	38.3	Ditto	....	....	....	14.3
S. S. P. Co.....		Steam.								

made to load up the most efficient units first, and with comparatively short transmission lines and low losses, the best combination of stations for the existing conditions at any minute is selected. All stations are synchronized and run in parallel; energy sometimes flows in one direction over a transmission line and sometimes in the opposite. The possibilities of storage manipulation are very limited, but in general the attempt is made to use all the water possible from the rivers with only pondage facilities and to make up the deficit from the storage in Lake Tapps, being careful however, to have all reservoirs full just before the peak comes on. Four steam plants are held in reserve to supplement the hydroelectric operation, but these have not been used for several years.

The Portland Railway, Light & Power Company also operates a typical system of this section in and about Portland, Oregon. All that has been said of

	Max. Head, Feet.	Minimum Head, Feet.	Effect of Variation in Head.	Generating Voltage.	Transmission Volts Out of Plant.	Rated Plant Capacity, 24-hr. kw.	Peak Plant Capacity, 1 hr., kw.	Sufficient Water to Operate Plant, Rated Load Throughout the year?	Is it Necessary to Draw on Storage to do This?	Pondage—Daily hrs. of Draw Out.	Pondage—Daily hrs. of Fill Up.	Steam Plant Type of Prime Mover.	Fuel.
Kern R. 1	865	865	None	2300	60000	20000	20000	No		5:00 p.m. to 9:00 a.m.	12:00 p.m. to 5:00 a.m.		
Mill Ck. 1	506	450	.....	2500	30000	750	750	No					
Mill Ck. 3	1825	1825	.....	750	30000	1200	1200	No					
S. Anna 1	715	700	.....	750	30000	3000	3000	No					
S. Anna 2	310	305	.....	750	30000	1200	1200	No					
					Long Beach	47000	47000					Turbine	Oil
					Los Ang. 3	10000	12000					Turbine	Oil
White Riv.	440	440	None	6600	55000	24000	30000	Yes	Yes	No Pondage	None		
Snoqual.	266	244	None	2000 & 6900	55000	19750	22000	No	None	5:00 a.m. to 10:00 p.m.	10:00 p.m. to 5:00 a.m.		
Electron	871	865	None	2300	55000	6040	22000	Yes	No	6:00 a.m. to 10:00 p.m.	10:00 p.m. to 6:00 a.m.		
			Georgetown	13800	13800	12000	13000					Vertical Turbine	Oil
			Post St.	2300	2300	3900	4000					Vertical Reciproc.	Coal
			Bond St.	2300 (550 d.c.)	2300 (550 d.c.)	1500	1500					Horiz. Trb. & Recipr.	Coal
			Nooksack Falls.			1500	....						
			York St.	2300	2300	3030	....					Horiz. Turbine	Coal
			Purchased		60000	5000	...						
	435	420	None	11000	100000	50000	55000	Yes	Yes	Summer	Winter		
						10000	10000					Turbine	Oil
						16000	22000					Turbine	Oil
River Mill	81	70	None	11000	57100	9900	12375	No		5:00 p.m.	11:00 p.m.		
Ore. City	40	10	None	11000	11000	7230	8770	No		5:00 p.m.	11:00 p.m.		
				11000	57100								
Cazedero	132	110	None	2300	33000	14250	15500	No		5:00 p.m.	11:00 p.m.		
Bull Run	325	292	None	6600	57100	11250	11250	No		5:00 p.m.	11:00 p.m.		
					N. Portland	12500	12500					Trb. Vert. Rec.	Mill Waste and Oil
					E. Portland	6000	8000					Trb. Corliss	Ditto
					St. Johns	2500	3125					Turb.	Ditto
					Salem	1000	1000					Recip.	Ditto
Post Falls	45.92	45.92	None	2300 4000 600	60000	11250	13500	No	Yes				
Spokane	72	72	None	300	60000	8800	8600	No	None				
Little Falls	65	65	Yes	4000	60000	20500	23625	No	Yes	3:00 to 11:00 p.m.	11:00 p.m. to 6:00 a.m.		
San J. 1	1411	1411	None	2300	60000	16000	18000	No	Yes				
San J. 3	401	401	None	550	30000	2000	2500	No	Yes				
Tule	1463	1463	None	2300	60000	6000	7000	No					
Kern	211	211	None	500	10000	1350	1350	Yes					
					Bakersfield	16550	18600					Turbine	Oil & Gas
					Fresno	750	750					Recip.	Oil
					Santa Maria	200	250					Recip.	Oil
					San Luis Ob.	130	150					Recip.	Oil
	120	100	None	4400	60000	36000	50000	Yes	Yes				
No. 2	900	900	None	2200	55000	4800	6000	No					
No. 3	780	780	None	2200	55000	5800	7200	No					
No. 4	950	950	None	2200	55000	4800	6000	No					
No. 5	380	370	None	2200	55000	1500	1600	Yes					
No. 6	240	235	None	2200	55000	1800	2000	No					
S. S. P. Co.						3000	7000					Turbine	Oil

the Puget Sound people and country is true also of the Portland district, excepting that marine commerce is very limited and to the south agriculture is more extensive. The load has the same characteristics and about the same load-factor, possibly as low as 60 per cent. The company has four hydroelectric plants, River Mill and Cazadero on the Clackamas River, Oregon City on the Willamette, and Bull Run on the Big Sandy, feeding into its system of transmission lines from the outskirts, and four steam stations, two of which operate during low water season to make up the deficit in peak kilowatts. There is no storage reservoir, but each plant has a pondage basin in which the flow is stored during the night. The load is distributed by a central load dispatcher and an effort is made to conserve water by loading the most efficient units first. It is interesting to note the Oregon City plant on the Willamette River, which was one of the



Pacific Light & Power Company's Big Creek Plant.

first hydroelectric developments in the West, and possibly the first to be synchronized with another alternating current generating station. It is equipped with vertical turbines, two on each generating unit, one a 42 in. runner for use when the head is high (up to 40 ft.) and the other a 72 in. runner for use with low heads down to 10 ft.

California Companies.

To describe here the system of any one company would not be representative and would be unfair to the twenty or more other corporations which operate about 76 plants in California, hence a few generalizations and references will be given. The average daily load factor is about 65 per cent, because the bulk of the business is in supplying people in the cities and miscellaneous manufacturing. Some of the systems run up as high as 75 to 80 per cent, as the Southern Sierras Power Company, which has considerable constant load in irrigation and mines. Other companies which are new in the field drop as low as 50 per cent, not having yet acquired any considerable 24 hour power business, and are retailing to the commercial trade. The Southern California Edison Company supplies energy to Los Angeles and vicinity from six water power and two steam stations and is the only one of the several companies mentioned that carries the entire system regulation on steam, while the hydro stations operate at or near unity load factor. The Big Creek plants of the Pacific Light & Power Corporation are interesting for the high heads utilized. Plant 1 draws water from the storage reservoir under 2009 ft. of head and discharges it in the forebay of Plant 2 on which the head is 1815 ft. The transmission is to Los Angeles and vicinity, 240 miles, at 150,000 volt pressure. This system also is supplied from four other hydro stations, Sierra, Mentone, Borel and Azusa and Redondo steam, making a total capacity of 120,000 kilowatts. The Pacific Gas & Electric Company serves in part the San Francisco district from eleven hydroelectric plants and four steam plants. None of the electric plants have any considerable storage facilities and steam is used continually to generate at the center of load, San Francisco. The highest head is at the de Sabla plant, 1531 ft. The Great Western Power Company also serves the San Francisco country from one hydroelectric plant at Big Bend on the Feather River, and two steam plants, Oakland and San Francisco.

Pacific Gas & Electric Company's Lake Spaulding Dam.

The head at Big Bend is 435 ft. and the reservoir holds 54 million kilowatt hours. In all the systems where pondage exists the most efficient units are loaded first and water is conserved during dry periods; but where the plants run on flow only, they are kept at as nearly 100 per cent load factor as possible and the regulation is taken on steam or storage plants. No effort is made to keep the plants nearest the "center of gravity" of the system loaded up since transmission losses do not exceed 20 per cent and average 15 per cent.

In concluding the foregoing descriptive narrative, we present the tabulation of data on leading Pacific Coast systems that has been referred to.

Summary.

Of all the estimated available power on the Pacific Coast, only 2 per cent is now developed, and of this amount available, California has 57.5 per cent, Oregon has 17.5 per cent and Washington 25 per cent.

At the present time there are but four developments that have any considerable storage reservoirs. This is because there has been much more power available than the market has demanded, and it has been more profitable to utilize the minimum flow of a number of rivers than to create storage facilities; and also, because before the advent of efficient high tension long distance transmission it was impracticable to build storage lakes of considerable size near the centers of loads. However, the increasing market, the decrease in available cheap water power sites, the growth of population, and refinements in generation and transmission have made it necessary and possible to build plants of sufficient storage capacity to operate continuously the year around, and such is the present tendency.

While in theory it is desirable to carry the most efficient units of a system fully loaded longest, there are so many local conditions at each place that this practice can be observed only as a general consideration.

The storage being limited in quantity, there has never been an opportunity to develop any general practice along this line, beyond taking care to drain the reservoir by the end of the dry season and thereby avoid having to generate that many kilowatt hours by steam.

The low load factor shown by most of the systems has brought up interesting considerations of the value of peak power and the relative cost of steam and hydroelectric generation to carry the short high peak load. It has been shown that with a 50 per cent daily load factor, 60 per cent of the capacity will generate 90 per cent of the kilowatt hours and that the peak requires 40 per cent of the capacity to generate only 10 per cent of the kilowatt hours.

The production of sulphuric acid, expressed in terms of 50 per cent acid, in the United States in 1915 was 3,868,152 short tons, valued at $29,869,080 together with 189,795 short tons of oleum or fuming acid of different strengths, valued at $2,787,971, making a total of 4,057,947 short tons, valued at $32,657,051. These figures include so-called by-product acid produced at copper and zinc smelters. The production of acid from this source in 1915 was 1,056,830 short tons, expressed in terms of 50 per cent acid, valued at $7,042,126.

FIRE PROTECTION OF ELECTRIC PLANTS.

BY M. E. CHENEY.

(Concluded.)

Typical Steam Power Plant.

Station is of brick 100 ft. my 100 ft., 25 ft. high. Walls are of brick 14 in. in thickness, strengthened by brick pilasters 26 in. by 18 in. spaced 14 ft. centers. Roof, joisted construction. Station divided into two sections of equal area by a 16 in. brick wall to roof only; wall has three unprotected communications of ordinary size. Section on north occupied by boiler plant; that on the south by generating and switching apparatus.

Referring to our schedule we find that a building having standard brick walls takes a basis rate of $.58 per $100 of insurance carried.

Investigating our station now for chargeable deficiencies we will note the following:

	Basis	.58
1.	Partitions—These are of brick or tile and are standard.	
2.	Parapets—Standard; all exterior walls rising well above the roof; no charge to be made.	
3.	Roof—Composition on wood sheathing on wood trusses; charge	.10
4.	Unprotected metal—None.	
5.	Skylights—None.	
6.	Floors—Concrete; standard.	
7.	Stairs and floor openings—Station one-story. Stairs to condenser pit only; no charge.	
8.	Finish—Open; no concealed spaces.	
9.	Exterior attachments—Frame ventilating monitor with plain glass in wood frame sides; charge .04 plus .02 for glazing	.06
10.	Area—10,000 sq. ft.—excess 2500 sq. ft. at .01 per 1,000	.03
11.	Height—One-story only; no charge.	
12.	Lighting—Electric; incandescent. Wiring open and defective	.05
13.	Heating. Steam; standard.	
14.	Fuel oil—None.	
15.	Occupancy—Steam generating station only.	
16.	Conductors—High tension conductors; 25,000 volts; arranged as in standard; no charge. Low tension conductors; 2300 volt; rubber covered, run on porcelain cleats and grouped in a common raceway in floor. Trouble in one conductor could readily extend to others; charge	.05
	All conductors equipped with proper protecting devices.	
17.	Switchboard—12 panel; slate on metal frame; standard.	
18.	Resistances—Of approved type but mounted on combustible supports; charge	.05
19.	Lightning arresters—All circuits equipped; arresters of electrolytic type mounted outside station; standard	
20.	Transformers—Two 2000 kw., oil-filled, water cooled, mounted on floor of station; not enclosed as in standard; charge	.03
21.	Boilers—Of Stirling water tube type; standard brick settings. Boilers in section separated from generating section by 16 in. brick wall rising to roof only and having numerous unprotected openings; charge	.10
22.	Stack—Metal; passing through combustible roof with insufficient clearance; charge	.10
23.	Gas engines—None.	
24.	Waste cans—None; charge	.02
25.	Lockers—All of wood; charge	.02
26.	Oils—Large quantity of lubricating and transil oil stored on station floor proper; charge	.15
27.	Watchman—Plant in continuous operation.	
	Protection—Private.	
28.	Sand pails and extinguishers—None; charge	.05
29.	Standpipes and Hose—None; charge	.05
	Protection—Public.	
30.	Water supply—Adequate, and mains of approved type and adequate size; 8 in. main 100 ft. from station.	
31.	Hydrants—Only one within 300 ft. of station; charge	.02
32.	Hydrants—Of standard type.	
33.	Location of Fire Department—Within one-half mile; auto driven apparatus; no charge.	
34.	Fire Department—Partially paid only; charge	.02
	Fire Department—Equipment adequate; no charge.	
38.	Fire alarm—No box within 300 ft.; charge	.02
39.	Care and maintenance—Fair only. A number of packing cases and excelsior just outside of and against building; charge	.10
40.	Age and condition—Fair; no charge.	
41.	Exposures—Frame fuel bin 25 ft. from boiler room. Shavings and refuse used for fuel. Fed to boilers by conveyor. Exposed wall of power plant has several unprotected openings. Exposure is graded as ordinary account of size and carries rate of $2.00; absorbed charge being 16 per cent. Charge reduced by one-half account distance and by one-fifth account same ownership. Exposure charge 2.00 times .16 times .50 times .80	.13
	Building and general contents	$1.74

Electrical machinery and apparatus because of being more susceptible to damage from fire and water than other classes of apparatus and building, takes a higher rate than general contents and building. This differential is based on the nature of the building

and is 15 cents where floors or roofs are of combustible material and 7 cents where of non-combustible construction.

Electrical contents then in our plant carries a rate of 1.74 plus .15 or.....$1.89

A further differential is made in the rates for the attachment to the policy of an 80 per cent co-insurance clause. This clause means that the assured must carry insurance equal to or in excess of 80 per cent of the value of the property insured. Fulfilling this requirement, the clause does not apply any more than if it were not on the policy. Only in the event of failing to fulfill this requirement, does the assured pay a penalty by becoming a co-insurer or an individual self-insurance company, insuring himself to the extent of such deficiency or shortage.

Establishing a rate under the consideration of a co-insurance clause is not only more satisfactory to underwriters but is more equitable to the assured, for such rate takes into consideration the relation of insurance to value.

In risks of the type and character of power plants and substations the average loss per fire is considerably less than total and that fact is given consideration in fixing the premium rate.

Without the co-insurance clause a certain property owner, relying on this relation of loss to value, may take the chance of carrying less insurance than the value of his property and consequently while he might lose but 50 per cent or so of this value, the underwriters insuring him would sustain a total loss—exhausting the policy while the loss to the property is only partial.

Insomuch as it is often difficult to determine the exact value of insurable property, it was decided to fix 80 per cent of insurance to value as a standard which is not too onerous for the assured and still gives the underwriters a good basis on which to compute rates.

For the attachment of an 80 per cent co-insurance clause then a reduction is made in the rates as given by schedule above of $.50, giving:

Building and general contents	$1.24
Electrical contents	1.39

Correction of Defects.

Now the protection engineer, in an effort to minimize the hazard in the plant, notes from a survey of the plant that there are a number of defects in construction and equipment contributing to the hazard which may be readily corrected. Let us glance at some of these:

12. Lighting—Very probably if the present installation were carefully overhauled it could at small expense be placed in a standard condition for open work. If this approved condition were attained then the charge of 5 cents made because of non-standard condition could be reduced to 1 cent—1 cent being the charge for open work in standard condition. This gives a credit for correcting this defect of $.04.

16. Conductors—If these are relaid in standard manner charge for present condition may be omitted; credit .05.

18. Resistances—If these are standardly installed, that is, on metal supports, and isolated from all woodwork; charge of 5c for present condition may be omitted; credit .05.

22. Stack—If the iron stack be given ample clearance and ventilating hood properly installed; the charge of 10c for its present condition may be reduced to 2 cents; credit, .08.

24. Waste cans—If a sufficient number of approved waste cans are installed, charge for their absence may be removed; credit .03.

25. Lockers—If standard metal lockers are installed in place of present wooden lockers charge may be omitted; credit .02.

26. Oils—If an oil house be constructed, say at least 50 ft. from the station and all oils except the permissible quantity removed from the station, charge of 15 cents for oil may be omitted; credit .15.

28. Internal protection—Since the area of our station is some 10,000 sq. ft., complying with the rule for number of sand pails and chemical extinguishers, three of the former and one of the latter to each 4000 sq. ft., we would require eight sand pails and three chemical extinguishers, these to be distributed through the two sections of the building, preferably two of the extinguishers being in the generating section. With reference to the type of extinguisher, those of the acid and soda type are recommended in stations in part of combustible construction. The carbon tetrachloride extinguishers are, however, valuable for oil and electric fires. We therefore would recommend that a carbon tetrachloride extinguisher be substituted for one of the soda extinguishers in the generating section. All extinguishers should bear the underwriters' label. Soda extinguishers should be re-charged at least once yearly and should be provided with a tag on which is kept an accurate record of the charging dates. If sand pails and extinguishers are installed as recommended then the charge of 5 cents for their absence may be removed; credit .05.

29. Standpipes and hose—To extinguish or hold in check fires which have passed the incipient stage more water is necessary than can be furnished by pails or hand extinguishers. This condition is best met by interior standpipes and hose. Hydrants should be placed in each section and should be fed by not smaller than a 3 in. pipe. These should be located so that with not more than 75 ft. of hose on each any part of the station may be reached. In our station we would require probably to meet the best conditions—depending, however, upon the arrangement of the apparatus, two 1½ in. hydrants in each section. Hose should be of linen of an approved make not less than 1½ in. in diameter with ¾ in. nozzle and for our station in possibly 75 ft. lengths, hung on a rack. Hose to be attached to hydrants and have nozzle attached so that in event of fire no time will be lost in applying the stream. Hydrants should have an adequate supply of water at a pressure sufficient to throw streams over the highest point of buildings. Supply to be from city service where practical; otherwise from a standard 500 gallon per minute underwriters' pump available for immediate use or from an elevated tank of not less than 10,000 gallons. All pipe if exposed to be protected from freezing. For the installation of standpipes as proposed the charge of 5 cents for their absence may be removed; credit .05.

31. Hydrants—If one other standard city hydrant be installed on the 8 in. main within 300 ft. of the plant, the charge for but one hydrant may be removed; credit .02.

38. Fire alarm box—If a municipal fire alarm box be placed within 300 ft. of risk, charge of 2 cents for its absence may be removed; credit .02.

39. Care and maintenance—If all the unnecessary combustible material about the plant be dispensed with and the building and surrounding grounds be kept at all times in a neat and tidy condition, a charge of 10 cents for present condition may be removed; credit .10.

41. Exposures—Insomuch as the frame fuel bin in more than 20 ft. from power plant if the unprotected openings now in the exposed wall of the plant be protected by approved wired glass in metal frame, or by standard metal-clad or metal shutters then the exposure charge of 13 cents may be removed; credit .13.

The correction of the above defects results in a total credit of .79.

This means that our former rates will be in each case reduced by $.79, giving the following:

	Old.	New.
Mode 1—80 per cent co-insurance clause:		
Building and general contents	$1.24	$ .45
Electrical contents	1.39	.66
Mode 2—No co-insurance clause:		
Building and general contents	1.74	.95
Electrical contents	1.89	1.10

Comparing rates made before the remedial defects were corrected with those under the improved condition a reduction is shown of more than 50 per cent in the Mode 1 rates and of nearly 50 per cent in the Mode 2 rates.

Or from another angle, for every $100 of insurance carried a saving of 79 cents in the premium is made. If our plant were insured for $100,000 then the saving per annum would amount to $790—10 per cent interest on $7900—more than enough to correct the defects as outlined. Surely a proposition which should strongly appeal to the business judgment of each manager even if he were so blind as to overlook the real advantage to be gained—a plant practically immune from damage and a service proof against serious interruption by fire.

The deficiencies to which your attention has just been called are those readily corrected and do not in any sense conclude the list of chargeable defects. Further reductions may be made for a proper arrangement of transformers. If the brick wall between the boiler room and generator room were carried through the roof and the openings bricked up or protected by double standard automatic fire doors—then would not only the charge of 10 cents for boilers not apply to the generating room but the two buildings would be sep-

arately rated and other deficiency charges apply only to the section in which such deficiencies obtain.

Methods of Rate Reductions.

We hear continually that insurance rates are too high. Undoubtedly they are—yet based on the loss ratios, the rates are much lower in the United States than in Europe, notably Germany, which has an average loss of 12c per $100 insurance carried as against 64c in the United States. This is not to be wondered at when it is remembered that more insurance premiums are collected in the United States per annum than in all the rest of the world combined. Commodities in quantities cost less per unit, so it is with insurance.

Quoting in part from an authority in matters pertaining to insurance—"There are just three directions in which insurance rates may be reduced.

1. By reducing the profits.
2. By reducing the expense.
3. By reducing the losses."

The average of 3½ per cent residue from the premium income, from which small percentage must be extracted—profit and accumulation for the next conflagration—leaves the profit far too small and unreliable to tempt much new capital, particularly in the fact of past experience; and by the way, the values just quoted will from all indications have to be revised, for the report of the insurance commissioner of the state of Washington for the year 1915 disclosed the fact that from their underwriting business insurance companies operating in that state realized not a profit but on the contrary sustained a loss of 5.8 per cent. Out of 1400 or 1500 companies organized in the past 50 years, there have been over 1200 failures and retirements from lack of profits. Rate reduction in this direction then does not seem practicable.

With reference to a reduction in expenses—scientific methods of management are employed and the work is done with marvelous efficiency, with no more waste than in other businesses. Competition and the natural value of the service rendered have regulated the expenses of fire insurance the world over. They are about the same all over Europe, South America, Asia, Australia, United States and Canada. Surely if a reduction of expenses were possible, companies in some of these countries, at least, would endeavor to increase their profit by so reducing them.

There remains then the only one unquestioned way to reduce the rates. That one way will also automatically reduce the volume of expense and profit. The moment we reduce the fire loss in this country to the European standard, that moment will we get the European rate standard. When we have cut down our 64c loss on every $100 insurance carried, to the German figure of 12c, we will get the German rate of 22½c. Not before, because it is a plain mathematical process, not a financial juggle.

In conclusion I want to state that The Washington Surveying and Rating Bureau under the State Insurance Code is public service in character and not only is it anxious to co-operate with you to reduce to a minimum losses from fire, but will also gladly furnish you with surveys or ratings of all properties under its jurisdiction in which you are interested.

FEASIBILITY OF ELECTROCHEMISTRY AT THE DALLES.

BY O. F. STAFFORD.

(Continued.)

Calcium Carbide.

The calcium carbide industry has had a most checkered career since its beginning in 1892. The wonderful properties of carbide led to an enthusiastic over-development of the industry which reached a crisis in 1899, since which time production has been restricted by selling agreements, as far as European manufacturers are concerned, and by a monopoly in both manufacture and sale in America.

The industry has been retarded by the rapid development of electric lighting, doubtless, and it now appears that electricity will replace acetylene even in the field of automobile lighting. An assured place seems to exist for acetylene in the metal-working industries, however, where it is finding an increased use in autogenous welding. Calcium carbide is also an intermediate product in the manufacture of calcium cyanamid, a substance through which atmospheric nitrogen is utilized for the production of nitrogen compounds useful in the fertilizer industry and in other fields of chemical manufacture. In this last use of carbide there seems to be an unlimited field for production. The matter will be considered at length in a later section of this report.

The raw materials for carbide are lime and carbon, the latter being necessary in the form of either low-ash coke, charcoal, or anthracite coal. The process of manufacture consists in heating the lime and carbon together to a temperature of about 4000 deg. F. when the carbide forms as a melted mass which, upon cooling, solidifies and may be broken up, sized, and packed into air-tight containers for shipment.

The world production of calcium carbide, for uses other than the making of calcium cyanamid, is about 300,000 tons, of which one-fourth is made in America by a single concern which controls the industry. The world production absorbs 180,000 horsepower-years of electrical energy.

Recent tariff legislation has placed carbide upon the free list for importation, but so powerful is the single carbide interest in this country that importations have so far been negligible. On the other hand, carbide has been exported from time to time and sold abroad in competition with that produced by the unusually cheap water-powers of Europe.

Distribution statistics are not available, owing in a measure to the monopoly existing in sales as well as in production. A probable assumption is that the distribution of carbide consumption is parallel to the distribution of population, which would make the consumption in the Pacific Coast territory not over 3000 tons per year at most. It is authoritatively stated that a factory to operate under the most economical conditions should make about eight times this quantity.

As nearly as can be estimated in the light of the unsatisfactory information available, it appears that carbide manufacture in the East in a plant making 25,000 tons per year could be carried on at a cost not exceeding $35 per ton of product packed and ready

for shipment. This assumes the use of 16,000 horsepower-years of electrical energy at $15; a capitalization of $250,000 with an eight-year amortization period; interest 5 per cent; carbon $6 per ton; coal $3 per ton; lime $5 per ton.

A parallel computation for western conditions gives a cost of $38 per ton, assuming the cost of energy to be $9 per horsepower-year; capitalization $280,000; labor 115 per cent of that in the East; interest 5½ per cent; carbon $8 per ton; coal $5 per ton; lime $6 per ton. It is seen that this advance over the cost at an eastern locality must limit carbide production upon the Pacific Coast to that consumed locally. Were it possible to serve the carbide demands of all countries bordering upon the Pacific a plant producing 25,000 tons per year might be a possibility of the future, its success depending obviously upon the genius of the man in charge of its sales department.

Chlorates.

Although the manufacture of potassium chlorate in all probability never will consume large blocks of electric power in the sense that the aluminum or carbide industries are power consumers, yet the manufacture of this substance might bear an important relationship to the development of the Pacific Coast states because of its possible use in the making of cheap explosives.

Chlorate powders have in general been in disrepute owing to the fact that early attempts to make them resulted in disastrous premature explosions which for many years deterred further experimentation. Lately, however, it has been found possible to make and keep chlorate powders with as little risk as in the explosives industry generally so that their use is increasing. There would seem to be an extensive demand in the West for these powders in road-making and land-clearing if their cost relative to other explosives really works out to be less. With the use of mixtures of the rack-a-rock type, especially, a development in this direction is promising.

The extent of the demand for chlorate powders in the West is a problem which it is impossible to solve at present since there is the question of their ultimate superiority yet to demonstrate and in addition to this a long campaign of education among consumers before it may be expected that a new explosive may be substituted in practice for a familiar one. The chlorate powder industry must also expect to meet the competition of the very strong business concerns making other explosives. A local manufacturer of chlorate powder, however, asserts an immediate outlet for as much as 2000 tons of chlorate per year if it were available at a reasonable price, with an indefinitely increased consumption as the merits of chlorate powder would become known. A manufacturing unit capable of turning out 2000 tons of chlorate per year would be large enough, it may be said, to operate advantageously from an economic point of view.

The only raw material required for making potassium chlorate is potassium chloride, the "muriate of potash" of commerce. The sole present source is in Germany where production and sales are under the control of the well-known Kali Syndicate. The efforts made lately by the federal government to develop an independent domestic source of potassium compounds are summarized elsewhere in this report under the discussion of raw materials.

Domestic consumption in the United States is entirely of domestic manufacture, several factories being in operation in the East and Middle West. Their production in 1909 was 12,000 tons. Sales are made under agreements, apparently through a single selling agency. The price in New York just prior to the outbreak of the war was $140 per ton. Freight to coast points was $23 per ton by rail. No rate upon this commodity via Panama seems to have been made as yet.

Exact cost data in the manufacture of chlorate under American conditions are not available. An estimate gives a figure near $95 per ton as the probable cost under normal international conditions at an eastern factory site. The manufacture of a ton of chlorate requires something over one horsepower-year of electrical energy together with the equivalent of 1200 pounds of potassium chloride. This comparatively large power consumption per unit of product is favorable to the commercial success of a factory at a western site and undoubtedly all chlorate which could be consumed in the West could be manufactured advantageously here. Considering that the raw material potassium chloride should always be cheaper in the East than in the West owing to the shorter haul from Germany it does not appear that western-made chlorate can ever compete in the eastern market. Even the development of new sources of potassium compounds, as for example from western kelp, alunite or leucite, would be unlikely to affect this situation owing to the absolute power of price control possessed by the German syndicate.

The manufacture of sodium chlorate instead of potassium chlorate would do away with the dependence of the chlorate industry upon potash as raw material since common salt would be used instead. The substitution of the much cheaper sodium chloride should lead to substantial economies in manufacturing costs in spite of the fact that the technical difficulties to overcome are somewhat greater. Sodium chlorate is for many purposes not as desirable as the potassium compound owing to its tendency to absorb moisture. Very satisfactory explosive mixtures are made, however, in which the chlorate is protected against any possibility of moisture absorption by the nature of the other constituents. The logical development of the chlorate powder industry might therefore be in the direction of the use of the less expensive sodium chlorate.

(To be continued.)

PEP'S FAMILY TREE.

BY THEO E. BURGER.

Progressivenes.	Energy.	Persistency.
Punctual.	Efficient.	Patient.
Resourceful.	Nimble.	Enduring.
Obliging.	Encouraging.	Retentive.
Generous.	Right.	Sensible.
Reliable.	Genial.	Impartial.
Exact.	Youthful.	Self-possessed.
Self-confident.		Truthful.
Sedate.		Entertaining.
Industrious.		Naive.
Vigilant.		Consistent.
Enthusiastic.		Yearning.
Noble.		
Eager.		
Sagacious.		
Systematic.		

SALIENT FEATURES OF N. E. L. A. PAPERS.

The following abstracts of advance copies of papers presented at the Chicago convention of the National Electric Light Association, May 23-26, 1916, have been especially prepared with Pacific Coast interests in mind:

The progress report by Secretary T. C. Martin shows that in the United States in 1912 the total investment in electrical properties was eight million dollars, representing 4.3 per cent of the total wealth of the nation. The capacity of central stations is increasing rapidly, but their number is decreasing gradually, owing to centralization. The earnings for 1915 was $360,000,000 an increase of $24,000,000 over 1914. The output was 18,400,000,000 kw.-hr., an increase of 1,800,000,000 kw.-hr. The annual per capita central station consumption in New England is 200 kw. hr., in the Middle West 500 kw.-hr. and on the Pacific Coast 500 to 740 kw.-hr. Foreign progress has been much less than American. Comprehensive summary is given of notable developments in technical, commercial and legislative matters during the past year in Mr. Martin's admirable style.

Technical and Hydroelectric Sections.

The meter committee report tells of an annual addendum to keep the Electrical Metermen's Handbook up-to-date. A lecture on meters has been prepared for section meetings. Instrument transformers are completely discussed as regards standardization of design and methods of testing. Portable batteries are recommended as a source of current for meter tests. Recent developments described include the following: A deflection potentiometer giving rapid readings to .001 volt; type CS-3 watt-hour meter, a cheaper form of type CS double armature astatic switchboard meter because the magnet shield is omitted, an improved form of Type P demand meter, and type E 6 potential transformer, all manufactured by the General Electric Company. Westinghouse new products described include type "OA" prepayment attachment for making a cheap prepayment meter from a standard service meter, type "RA" recording demand watt-hour meter, an outdoor metering equipment set for three-phase circuits up to 66,000 volts; a switchboard potentiometer for measuring temperatures of apparatus distributed about a plant; d.c. indicating instruments for heavy power circuits, and a portable cycle-counter specifically intended to indicate the number of cycles required for a protective relay to close its contacts and for any other timing purpose where intervals are too short to be observed with a stop watch. Duncan developments include their model M-2 a.c. watt-hour meter, M 2P polyphase watt-hour meter and a new line of current and voltage transformers. Weston new developments are the "potential transformer comparator voltmeter," designed to quickly and accurately compare the ratios of two potential transformers, and a new double-range ohmmeter operated on dry cells without rheostat and giving direct reading of unknown resistance in ohms. The Eastern Specialty Company has brought out a complete line of test-blocks, test-switches and test devices providing means for cutting out meters, short circuiting current transformers and obtaining testing current without disturbing the wiring or permanent connections. The Sangamo Economy railway meter is specially designed for severe use.

Electrical Measurements, Values and Terminology Committee recommends the abandonment of the horizontal candlepower and the adoption of the total emitted lumens as the universal basis of the output rating of illuminants. It recommends that all publications of the association be edited in exact accord with the terminology reports already submitted and approved. It recommends that all references in the publications of the Association to English units of measure be followed by their metric equivalents in parenthesis. The committee also submits a list of names and abbreviations and guides for style in text tables.

Lightning protection for transformers on 4000 volt distributing circuits is the subject of a paper by D. W. Roper, wherein it is shown that interruptions to service may be lessened by using transformers having their primary terminal boards either removed or submerged, and by installing arresters on transformer poles instead of line poles, thus eliminating about 90 per cent of the trouble former experienced in Chicago.

Underground construction for a. c. distribution has been hampered by a lack of dependable high voltage primary fuses and junction boxes. These difficulties have been partly helped by immersing fuses in oil and damping the explosion of a blowing fuse by means of an air cushion trapped in a horizontal tube mounted in the center of the fuse holder. Manhole oil fuses and junction boxes are used to disconnect cable sections. Operation of transformers in multiple has also helped. Cheaper construction is possible by using one service box to supply an entire block or group of customers. Stone conduit made of concrete localizes burn-outs. Manholes have been built in quicksand by a modified open caisson type of construction at about double the labor cost. Cables are carried under rivers by tunnels. In pulling cables, power trucks equipped with lighting storage batteries are recommended. Time can be saved in making repairs by using Conducell cable joint insulators. A new type of joint employing a metal sleeve and made under vacuum is in successful operation. Unit packages for cable joint material is recommended. The Knopp d.c. line testing set for measuring single conductor cable without opening the circuit is described. Account is given of a new method of trouble hunting employing an interrupter for the development of signaling current for finding faults. It is suggested that investigation be made of the current carrying capacity of cables. Moisture troubles are believed to be due either to the joints or faulty sheaths. Outdoor potheads for pole connections are suggested for the insulated conductor of underground cable to overhead wires. The cost of manhole cleaning can be reduced by using large dump wagons and a small gang of men. Various systems of tagging and numbering cables are described. Several methods of cooling hot duct lines, driving gas from manholes and pumping out water are suggested.

Overhead lines and inductive interference investigations have been confined to exhaustive studies of the proposed National Electrical Safety Code of the U. S. Bureau of Standards and the famous Order No. 39 of the California Railroad Commission. The Safety Code, while it will undoubtedly tend to eliminate improper construction, embodies in its present preliminary form material increases over present practice and its possible influence in increasing construction costs and hindering development is viewed with apprehension. "The fact that the (inductive interference) order, nearly two years after its issuance, has been practically unenforced is an interesting commentary either upon the need for such provisions or upon their feasibility. There has, however, been little new construction during the past two years, and there may be considerable change in the situation when the power companies start to carry out general extensions." Ground return telephone lines are not good practice and power companies cannot be properly held liable for interference to telephone lines so constructed. Increase in construction cost will seriously restrict the future building of minor distribution lines and hence the serving of small and scattered loads.

Prime movers of special interest are the tremendous steam turbine ordered during the past year ranging as high as 50,000 kilovolt-amperes for a Curtiss turbine to be installed by the Detroit Edison Company and 60,000 kilowatts in a Westinghouse turbine for the Interborough Rapid Transit Company of New York City. Condenser development has kept pace with the turbines. The advantages of sand-blasting

of condenser tubes are detailed. A more rational method of rating boilers is advocated. Standard boilers of 350 lb. working pressure with 250 degrees fahr. superheat are being made. Considerable attention is given the fusion temperature of ash and its effect on the commercial use of coal as well as to various types of mechanical stokers. Water power developments have been notable for their scarcity, due to financial conditions and decreased cost of steam-electric power. Many data are given regarding the reliability of hydraulic prime movers and the principal sources of trouble. A standard method of determining the head on wheels under test is needed. The large gas engine continues to lose ground as a prime mover for central stations. The Diesel engine situation is analyzed.

Electrical apparatus is being rapidly standardized. Recommendations are presented regarding standardization of transformer sizes, voltages and taps. The uniform rules on service requirements for motors are giving marked satisfaction. The capacities of single generating units have increased more than three-fold during the past five years, the largest to date being 60,000 k.v.a. Suggestions are given for minimizing noise in substations. Outdoor switch houses and metering equipment are briefly discussed, as are also synchronous converters and the phase converter for giving single phase service from three-phase systems. A harmonic analyzer is illustrated and described and also a cycle recorder. Several novelties in lightning arresters are mentioned and safety appliances for switchboards described. An outline is given of various street lighting systems.

Central station power for railways and general uses is advocated as an economic necessity of the future in a paper by Fred Darlington, argument being made for increased centralization of power service.

Accounting Section.

Annual report forms for electric light and power companies as required by all federal and state regulating bodies as exhaustively and completely compared show wide differences and inconsistencies. Companies are put to much needless expense in furnishing information of little or no value. The committee suggests simplification and standardization and aims to submit for association approval a concise, concrete and standard form of annual report to be recommended to all public service commissions having control over electric utilities.

Purchasing and storeroom accounting procedure of the Edison companies at Brooklyn, Detroit, Chicago and Boston are used to illustrate principles recommended by the committee. These include the suggestion that emergency orders be paid for from petty cash; that all buying be centralized in a purchasing department, which should keep an invoice register, file requisitions and price lists, direct inventory taking and sell scrap, and that a committee consisting of the purchasing agent, general sales agent and one other pass upon all appliances intended for re-sale.

Customers records as kept by 600 companies are compiled and classified as to methods of obtaining meter reading information, preparation and handling of bills and ledger information. The use of adding typewriters in billing and ledger posting is illustrated. There are upwards of 5,800,000 electric lighting consumers in the United States and this means about 70,000,000 bills per annum.

Company section difficulties were discussed in a report presented to the general session and in several supplementary papers. The apathy in local organizations threatens further growth of Class B membership unless methods are improved. Some sections have suffered from lack of company support, members have been coerced into joining, the national dues are claimed to be too high in proportion to benefits received, the Question Box is of limited interest and specialized handbooks are wanted rather than canvention proceedings. The committee recommends greater support from member companies and an extension of the handbook idea to involve the issuance of 20 to 25 specialized texts instead of bound volumes of proceedings. Control of various employees' activities should be centralized in the company section and mentioned in a company bulletin.

Geographic sections affiliated with the national organization are recommended as desirable in the several parts of the nation, membership being extended to include public utility companies and employes other than central stations. It is suggested that interest be stimulated by sending to the national convention two members from each company who have contributed most during the year to the section's advancement; that section papers be printed at association headquarters, that mailing be centralized likewise; and that section reports be standardized.

Commercial Section.

The annual report of Chairman Becker reviews the activities of the various standing and operating committees and presents a number of valuable suggestions. Of the Christmas book 250,000 copies were sold, an increase of 100,000 copies over the year previous. This "Handbook" has been entirely revised and is now ready for distribution. Over 1000 students are now enrolled in the salesmanship course. The wiring committee is reporting on a standard plug for the socket end of cords and the standardization of concentric wiring and fittings. The suggestion is made that the Power Sales Bureau be known as the Technical Committee of the commercial section, but that its work should in no way conflict with the work of the Technical Section. The newly-formed Lighting Sales Bureau has amply justified its existence as shown by a splendid series of papers containing material of value to the lighting salesman. The suggestion is made to co-operate with the national electric piano manufacturers in the solution of minor electrical details and the marketing of their product. The extensive report of the Range Committee, which forms an important addition to the report presented at the Northwestern Convention is enthusiastically referred to by the chairman, as is also the report of the Committee on Industrial Heating.

The finance report gives ample proof that the commercial section is on a self-supporting basis, having a surplus for the year 1915 of $4953.05. The revenue derived from the sale of publications amounted to $15,239.81 versus $12,097.71 in 1914.

The Membership Committee reports 851 new members of the association. Many new members for the technical and accounting sections were also obtained. The suggestion is made that the new membership committee consist of a chairman and vice-chairman from each section, making it unnecessary for each section to have its own committee.

Publications were purchased by 300 member companies, an increase of 13 per cent over the number reported last year. The Christmas booklet had to go through three editions and of the Northwestern range report, in response to an insistent demand, 10,000 copies were distributed. Nearly 500 copies of the Merchandizing Report, 723 copies of Cushing's Manual and 137,817 copies of the booklet issued by the Society for Electrical Development on house wiring were sold to and distributed among the members ;110 new subscribers to the magazine "Rate Research" were secured. The committee has on hand for data for a booklet on "Better Industrial Lighting" and a publication entitled "One Thousand Uses of Electricity." The suggestion is made to publish a pamphlet on Electric Heating and Cooking, containing data which have been subjected to close scrutiny and can be vouched for as to their reliability.

The Handbook Committee reported the publication of the third edition of the Handbook. The most radical change over previous editions is a new and comprehensive index.

Under the new system additions and subtractions may be readily made, retaining the useful matter without confusion or repaging. The index is based on the numerical system, with divisions of classes of industries to which the applications apply. The master index now has over 1200 separate divisions representing kinds of industries or installations. The system was presented by Norman Macbeth. Considerable new material has been added to the lighting section on reflectors, calculation and design, exterior lighting of buildings, etc. The entire electric vehicle section has been revised and much new and valuable data on operating costs are presented. All new members of the section receive in addition to the Handbook, a desk file as well as pocket binder for use by the salesman. Sections are merchandising, ice-making and furnaces are now being compiled. The Handbook contains 800 pages, an edition of 6000 copies was ordered.

Education of Salesmen has been confined to introducing and conducting the course in Commercial Engineering. A prospectus of the course is presented. It comprises 8 lessons of Selling, 6 on Lighting, and 3 on Power. It obviates the necessity for special educational departments in most of the member companies; 1035 members are now on the roll. Company classes are organized, meeting under the guidance of a leader. An arrangement has been perfected with the Chicago Central Station Institute by which it conducts and compiles the course, which obviates the necessity of an expensive organization. Illinois leads in the number of students, the total being 167, followed closely by California with an enrollment of 156, while the cash price of the course is $12, most of the companies are advancing this amount and having it returned by the student at the rate of $2 per month. The committee outlines a course in magnetism and electricity, appliances, illumination, industrial heating, electric power and commercial management and suggests the addition of special courses in any branch of the business for which there appears to be sufficient demand.

The Way to Make a Salesman, by Earl E. Whitehorne, is summed up in the words "Get Right With Your Own Job." The central station salesman is lucky at the start, climbing aboard a vehicle that's on the way to opportunity. Let him feel that he is in business for himself. Let him take the attitude that here in this great growing industry is opportunity enough for him and le him make the manly boast within himself that he is man enough to grow great with this opportunity, to be a big success in this, his business. The author expounds ten concrete rules of conduct, a sort of central station salesman's decalogue. They may be summarized as follows: (1) To make a good impression on every person he meets. He will then not be forced to battle against prejudice. (2) Know enough about your company and the industry to inspire confidence. (3) Meet and know as many people of all classes as you can. (4) Be resourceful and prepared to offer more than just an argument. (5) Win the order now—poor salesmen call again. (6) Be strong in confidence and willing to take responsibility. (7) Create opportunity by creating new markets for yourself. (8) Educate and maintain friendly contact with your customers, for they are your most precious asset. (9) Co-operate with the electrical fraternity in your town and recognize their functions in the field you work in. 10. Co-operate. Fight hard in competition with your friends and with the records of your own achievements in past months and years. "We see all about us," says Mr. Whitehorne, "that the central station business man is assuming broader functions, rendering a greater service and is steadily becoming more and more the dominant force."

The Merchandising report states that the Hoskins wire patent situation is being adjusted in such a manner as to protect the interests of all parties concerned. The hope is expressed that progress will be made during the year in the attempt to standardize the connectors at the appliance ends of connecting cords. Under the captain "New Developments," R. D. Cutler discusses the increasing demand for development in domestic ranges, branding irons, washing machines for set tubs, dish washers, household refrigerating outfits, brooders, radiators, circulating water heaters, hand driers, etc. He states that there is still a sharp difference of opinion as to the relative merits of the radiant and non-radiant forms of heating units for ranges. A lamp socket, portable range for apartment house use has been one of the developments during the year. A machine that would cool air to a degree representing the consumption of fifty pounds of ice per day would, if it could be sold at a cost not to exceed $50, find a demand even greater than the demand for ranges. It is recommended that a sub-committee be appointed to make a study of therapeutic electric devices which are rapidly increasing in number.

"Standardization" is treated by J. V. Guilfoyle, who hopefully refers to the standardization of both devices at the ends of connecting cords. Copper finished and brass hollow ware appliances are disapproved by the committee. Standardization of wattages of appliances intended for similar functions is recommended as well as efficient packing cartons for appliances.

"Industrial Appliances" by C. N. Lewis suggests that the salesman or solicitor should first decide whether a scheme is feasible. He amplifies this principle by the following examples, which are discussed at length: (1) The impracticability of heating buildings unless current is sold cheaply. (2) Heating of bathrooms should not be considered impracticable. (3) Describe in full the nature of the work to be accomplished. (4) Learn why the customer wants to use electric heat. (5) Get a photograph, cut of sketch of machine or parts to be heated. (6) Describe the operation of the machine in detail, stating the class of work. (7) The amount of material per charge. (8) Maximum time for heating up. (9) Accurate temperatures must be given. (10) Rate of production per hour is important. (11) If water is to be evaporated from material, get the percentage and samples of the material. (12) If insulated, get nature and thickness of insulating material. (13) If there is ventilation give size of openings. (14) Give dimensions of oven box or receptacle, inside and outside, and if liquid, how deep. (15) Ascertain space available for heater. (16) State voltage and kind of current. (17) Ask if heater is subject to vibration. It is important also that all commercial apparatus be properly installed, with proper wiring, etc., and a periodical inspection of its operation should be made. The salesman should obtain his data on a filing card and a record be kept of all installations. A form of filing card is submitted embodying spaces for the answering of the 17 questions mentioned above.

"Incandescent Lamps," by Miss N. Nevins, strongly urges the establishment of a lamp maintenance service. There is, a "watt-hour" element in the merchandising value of every lamp sold which is above and in addition to the part it pays in making up the sum of kilowatts connected.

"Ranges" are discussed by W. G. Stetson from a merchandising viewpoint. He touches on the rate question to the extent of mentioning the fact that electric cooking cannot be economically performed at a rate exceeding five cents. There is a demand for certain makes of electric ranges exceeding the supply and one maker reports that his entire 1916 output of 20,000 ranges will soon be sold. Ranges, he believes, will be sold in the following order: (1) For the kitchenette apartment. (2) The housekeeping apartment. (3) The detached house of moderate construction. (4) The country residence. (5) The city residence. The kitchenette range should sell for about $25 and will then compete with a $10 or $15 gas range. Electric manufacturers are rapidly developing an improved line of electric fittings for range installations. Central stations are warned against following

(Concluded on page 421.)

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CONTENTS

Pacific Coast Hydroelectric Development 403
By John Harisberger.

Production of Sulphuric Acid 411

Fire Protection of Electric Plants 411
By M. E. Cheney.

Feasibility of Electrochemistry at The Dalles 413
By O. F. Stafford.

Pep's Family Tree 414
By Theo E. Burger.

Salient Features of N. E. L. A. Papers 415

Editorial 418
Notes.
Honor for the Pioneer Engineer.
Public Regulation of Line Construction.
Cooking by Wire.

Personals 420

Meeting Notices 420

Examination for Junior Electrical Engineer 421

News of Oregon Public Service Commission 421

News of California Water Commission 421

San Francisco Electrical League Baseball 422

Trade Notes 422

News Notes 425

The San Joaquin Light & Power Corporation is so appreciative of the California Railroad Commission's fairness in reducing their rates that it has filed a petition for a writ of review with the Supreme Court, alleging that the commission acted in excess of jurisdiction.

One result of the San Francisco Board of Supervisors' respect for the jitney vote is that each supervisor faces suit for $50,000 and the city for $140,000 because of a jitney murder, though palliatively called an automobile accident. Furthermore, Market street property owners are about to apply for a twenty-five per cent reduction in taxes because of jitney damage to business along this thoroughfare.

Honor for the Pioneer Engineer

The West has been pre-eminently the pioneer in things electrical, whether technical or commercial. This role has been one of necessity, not of choice. Western men were pioneers in building higher-head hydroeleceric plants, longer-distance transmission lines and cheaper distribution methods, just as they have been leaders in lowering rates and developing commercial loads, simply because they had to, and because they possessed the indomitable spirit and the indefatigible eenrgy to meet the categorical imperative.

If they must, then they will.

After having applied untried methods to overcome unprecedented conditions, their results are now being investigated and adapted to adoption into standard practice. In this adaptive process there is a tendency on the part of those who do not appreciative pioneer conditions to criticize pioneer methods, to impose certain limitations on bolder expedients employed in sparsely settled territory, and to cause the pioneer to think that his has been a thankless task.

A pioneer, unlike a prophet, seems without honor, save in his own country. If poets are prophets, then engineers are pioneers. This is indicated by the fact that in proportion to population there are many more members of the American Society of Civil Engineers, American Institute of Mining Engineers and American Institute of Electrical Engineers on this Western forefront than elsewhere in the country. The pioneer engineer on the frontier is modest and unassuming. He works for the love of it without thought of reward. He deserves tribute.

The pioneer has risen above his humble origin as a peon directly as service has been exalted as the ideal of human attainment. Literally one who serves, he has ever gone before to prepare the way for others.

He is the forerunner of progress, for whose highways his footsteps were the first surveys. He dared the desert and made it blossom with the rose, he mounted the mountains and wrested their treasures of metal, he swam the streams and harnessed their turbulence.

He is the courier of civilization, overriding precedent and ridding of the impossible by doing it. He plays the game at the outposts of empire and enjoys the playing, slave of the wonder-lust but master of nature-dust.

He is the soldier of fortune, always marching in

advance, clearing the obstructions, mending the roads and building the bridges. Restless, tireless and resistless, he maps the land and charts the sea, ever fighting against barbarism and retrogression—the military engineer.

He is the ambassador of evolution, the leader in science and industry and the benefactor of his race. Onward and upward is his course, ever wililng to lend a hand, to start new things and to mend the old,—the civilian engineer.

His deeds honor his name if men do not. His fame lies in the future, when he will have annihilated time and space by utilizing the infinite force that rules the universe. Hail!

Public Regulation of Line Construction

Among technical matters discussed at the Chicago convention of the National Electric Light Association this week none is of more vital interest to Western central stations than the report of the committee on overhead lines and inductive interference. This report mirrors the past year's developments in public regulation of line construction, especially as regards the national electrical safety code of the Bureau of Standards and the inductive interference order of the California Railroad Commission.

The proposed safety code has been the subject of numerous conferences all over the country. The Bureau has accorded engineers of the various interests affected every opportunity for discussion, thus bringing into co-operation and harmony widely divergent views. The final draft will be issued soon after a general conference on May 29th and 30th at Chicago. Then, for one year, the code will be submitted to the acid test of experience, when its rules for the safe construction, maintenance and operation of electrical stations, lines and equipment will be enforced by various regulating bodies.

The good effect of the code will be to make electricity safer in use by restricting inadequate construction and improper operating methods. Its bad effect, as apprehended by power engineers, will be to prohibitively increase the cost of distributing systems, or at least make necessary a raise in rates.

The same conclusions apply as regards rigid enforcement of the inductive interference order of the California Railroad Commission, which will probably be the guide for many similar orders unless sufficient funds are provided for the Bureau of Standards to conduct a far more searching investigation. However, it is to be noted that the telephone companies, having secured needed protection, are not likely to insist upon compliance with the more burdensome requirements. Telephone men realize that the growth of a district, and consequently an increase in telephone consumers is accelerated by the availability of cheap electric power, which in turn is largely dependent upon cheap construction of distributing lines.

The safety code and the inductive interference order are alike in representing a compromise between cheapness and safety. If future profits are not to be compromised an inverse compromise must be brought about between safety and rates. "Safety First" is a good thing, yet it costs money.

Just as non-interference with the satisfactory operation of telephone lines from inductive power lines requires balanced circuits to neutralize electromagnetic and electrostatic induction, so there is necessary a delicate balance between costs and rates. The balance wheel to bring about these adjustments and to establish equilibrium is the public service commission in each state. The power man will welcome these rules safeguarding electricity and protecting against inductive disturbances if he can be assured that the commissions' policy will likewise be to safeguard electrical investments and protect against financial disturbances.

So our candid advice is for electrical men in the West not to chafe under these white-collar safety requirements of the wise men in the East. Trust in the wisdom of the body which may have to enforce the regulation and prepare the facts to prove that safety first like perfect service is merely a matter of rates allowed.

Cooking by Wire

The one commercial section report of the National Electric Light Assocaition of peculiar interest to the West is that of the electric range committee, all members of which are Western men. The report is of such local value as to justify future publication in these columns. It is based on the firm ground that electric cooking is an assured success in the West. From the housewife's standpoint it is practical, and from the central station standpoint it is desirable. The four problems awaiting final solution are advertising, merchandizing, rates and water heating.

As regards the first two, the committee makes plain the fact that aggressive efforts must be made by the manufacturers, particularly as regards educational work and guarantees. Excellent suggestions are made in this regard, most of them being along lines heretofore advocated in these columns. Nearly five thousand ranges were in use on Western circuits at the end of 1915, and the number will probably be doubled this year. Most of these have been sold and installed by the central stations at cost.

The committee does not recommend any definite form of rate for general use, but shows that a three-cent rate is sufficient to attract most consumers. Experience has shown that an average family requires one hundred kilowatt hours monthly, thus giving a cost of about three dollars a month.

Electric heating of water is still a stumbling block in many localities. Rates, as well as apparatus, are largely experimental. Some form of electric water heating is desirable wherever electric cooking is being enjoyed. As instantaneous heaters cause a prohibitive peak, the concensus of opinion favors storage of heat imparted at times of slight demand for current. Water, on account of its high specific heat, has a greater thermal storage capacity than any other liquid or solid. In continuous service one kilowatt will raise approximately one hundred gallons of water one hundred degrees, Fahrenheit, in twenty-four hours. With proper insulation the heat loss is not serious.

Summarizing the committee's list of advantages, electric cooking is found to be dainty, economical and efficient, clean, certain, cool and controllable, appetizing, perfect and progressive, moderate, safe and sanitary. Surely any other fuel decamps the field when the initial letters of these several qualities are so significant.

PERSONALS

B. J. Klein, Pacific Coast manager of the Bristol Company, is at Portland.

S. B. Gregory, Pacific Coast manager of the Arrow Electric Company, is at Los Angeles.

Paul F. Steck will handle electrical lines for the Bailey Drake Company of San Francisco.

C .E. Nestor, Pacific Coast manager of the Wallace Novelty Company, is in the Northwest.

N. Abrams, manager of the Western Agencies Company of San Francisco, is at Los Angeles.

F. J. Cram, sales manager Electric Appliance Company, has returned to San Francisco from Seattle.

H. E. Sanderson, Pacific Coast representative of the Bryant Electric Company, is in the Northwest.

H. S. Yost, assistant Pacific Coast manager Trumbull Electric Manufacturing Company is at San Diego.

T. A. Von Bebber, electrical dealer of Petaluma, was in San Francisco for a few days on a business trip.

Julian Rowe, Chicago manager of the Crocker-Wheeler Company, spent a few days in San Francisco last week.

S. B. Clarke, superintendent of the Merchants' Central Heating Company of Spokane, has returned from Portland.

C. A. Sanborn, salesman for the Los Angeles branch of the Western Electric Company, was in San Francisco last week.

W. Brewster Hall, Pacific Coast manager Pass & Seymour, Inc., is making a month's trip through the Pacific Northwest.

O. W. Lane, formerly with Holabird-Reynolds Co., who was taken sick about six months ago, is convalescing at Los Gatos.

D. A. Wagner, manager Electric Agencies Company, has returned to San Francisco from a trip through San Benito and Santa Clara counties.

A. H. Noyes, salesman Electric Appliance Company has returned to San Francisco from a two weeks' trip throughout the Northern California territory.

J. E. Davidson, vice-president of the Pacific Power & Light Company of Portland, is attending the convention of the National Electric Light Association at Chicago.

H. W. Hoxie, sales manager of the Electric Railway & Manufacturers' Supply Company, left on May 17th for a trip to Nevada. He will make the entire state on this trip.

Samuel H. Taylor, president of the Electric Railway & Manufacturers' Supply Company, returned May 17th from a trip to the Causeway Celebration at Sacramento and a business trip to Stockton.

W. Popper, Interstate Electric Novelty Company, at San Francisco, has been attending the Pure Food Show at Ukiah and speaks in the highest terms of the displays being made by the different electrical houses.

F. W. Wood, Pacific Coast agent for the Gamewell Fire Alarm System, has returned to San Francisco from a trip through Nevada, Idaho, Utah, Oregon and Washington, while **A. F. Brown,** of the same company, has returned from a two weeks' trip through California.

Paul McKee, assistant to the president of the California Oregon Power Company of San Francisco, in company with **Wm. M. Sheppard,** commercial agent have completed a two weeks' inspection tour of the Trinity Center line in Northern California and report the work progressing rapidly.

W. P. Naser, Pacific Coast manager of the Trumbull Electric Manufacturing Company, has been promoted to take charge of the company's entire business west of Pittsburg. He is leaving for the East shortly and will probably spend several months there before visiting the coast again. **H. F. Yost,** assistant manager, will have charge of the San Francisco office during Mr. Nasser's absence.

A. R. Loughborough, who, for the past three years has been manager of the Salt Lake office of the Western Electric Company, has been promoted to the position of sales manager of the Cincinnati office of the same company and has assumed his new duties. Mr. Loughborough entered the service of the Western Electric Company thirteen years ago as stock clerk. In the comparatively short time which he spent in Salt Lake City he made a host of friends who were pleased to learn of his good fortune. **D. J. Butts** has been assigned to the managership of the Salt Lake office. Mr. Butts has been in Salt Lake City for the past three months. Prior to that he was in the Boston office of the Western Electric Company for five years, and he has been in the service of the Company for fourteen years.

MEETING NOTICES.

Portland Sections of A. I. E. E. and N. E. L. A.

The joint luncheon club of the Portland sections of the A. I. E. E. and the N. E. L. A. of Portland, Oregon, has discontinued its bi-monthly luncheons indefinitely.

San Francisco Electrical Development and Jovian League.

On May 17th, with T. W. Simpson of the Federal Sign System (Electric), as chairman of the day, the league enjoyed an interesting address by Judge Frank J. Murasky as to how the youth of today is being made a better man of tomorrow. He explained the purposes and procedure of the juvenile court and told of some of the results accomplished.

Los Angeles Jovian Electric League.

Ira J. Francis, manager of the local office of the John A. Roeblings' Sons Company, was chairman of the day at the luncheon given on May 17th, and furnished a good program. The meeting was "in the hands of the law" so to speak, the principal speakers being Oscar C. Mueller, a prominent local attorney, and Albert H. Elliott of San Francisco, who needs no introduction. "What is the Matter With the Law?" was the title of Mr. Mueller's address. He stated that the greatest difficulty that the lawyer had to contend with is the multiplicity of conflicting laws of the different states, and he also criticised our cumbersome methods of handling legal cases. He said that in the past fifteen years in this state, 17,000 bills were introduced, 5000 of which have become laws. The 1915 legislature alone, introduced 1900 bills, 771 of which passed. He praised the constructive work of the American Bar Association, and in closing made a plea for uniformity of legislation; not more law, but more uniform law. He was followed by Mr. Elliott, who gave a stirring address on the subject of "Co-operation."

Engineers' Corps of California.

One hundred and sixty engineers met at lunch at the Engineers' Club, San Francisco, May 20th, to learn of object, policy and membership of the Engineers' Corps of California. As briefly reviewed by Jos. D. Smedberg, its organizer, the body already has a membership of 271 engineers in various units throughout the state.

Captain Richard Park, Corps of Engineers, U. S. A., outlined the study and drill schedule to be followed by the organization during the next two years. The first year's course has three departments, military art, military engineering and other arms. The department of military art has two study schedules: (A) organization, administration, equipment, duties and training, (B) psychology of war, conduct of war, military history, military policy of the United States, and the functions of other arms. Schedule A has eleven subdivisions: map-making, field fortifications, reconnaisance, sieges, demolitions, battlefield illumination, communications,

general construction work and special services, castrametation, and seacoast fortifications. This schedule is to be completed by September 1, 1916, after which further details will be announced later.

Brigadier General W. L. Sibert gave his approval to the spirit of the organization, told of the duties of an engineer in the field and illustrated his point with an account of overcoming obstacles in the Philippine campaign. Lieut.-Colonel Thomas H. Rees, Corps of Engineers, spoke on the relation of the Engineer Corps of California to the Engineer Corps and other technical branches of the army. H. W. Crozier presided as chairman at the enthusiastic meeting.

EXAMINATION FOR JUNIOR ELECTRICAL ENGINEER.

The U. S. Civil Service Commission announces an examination for junior electrical engineer, for men only, on June 21, 1916, to fill vacancies in the Bureau of Mines, Pittsburgh, Pa., at salaries ranging from $960 to $1200 a year. The duties of this position will be to conduct experiments with electrical machines, lamps and other apparatus for the purpose of increasing the safety and efficiency of mining operations. The duties will include the design and construction of testing equipment and devices, under direction, the determination of the proper conditions for test, the making of observations, the recording of results, and the preparation of reports. Competitors will be examined in practical questions in electrical engineering (40), education and experience (60). Graduation from a four years' course in electrical engineering from a college or university of recognizzed standing and at least one year's experience in electrical engineering work outside the college are prerequisites for consideration for this position. Special credit will be given for experience in electrical investigative work.

NEWS OF OREGON PUBLIC SERVICE COMMISSION.

The Home Telephone & Telegraph Company of Southern Oregon has been granted permission by the commission to increase its farmer party line switching rates at Medford, Gold Hill and Rogue River but refused permission to change the rates at Jacksonville. The commission also refused to permit the imposition of a penalty for non-payment of bills, and a reconnection charge of 50 cents when service had been denied subscribers for failure to pay their monthly bills. Declaring that when it fixed the present rates of the company at a former hearing that it deemed the service between Medford and Jacksonville free, the commission refused to grant the company's application to establish a toll service between these two points. The application for imposing a charge of 5 cents for calls within, and 10 cents for calls on farmer and suburban lines without the limits of the cities served, when the calls are made by non-subscribers, the commission dismissed without prejudice. The rate increases allowed for farmer party-line switching are as follows: Medford, from $7.20 a year to $8.40; Gold Hill, from $3 to $6 for residence and from $6 to $10 for business; Rogue River, from $3 to $6 for residence and from $6 to $10 for business.

Declaring that the parties to the contract or franchise between a city and a public utility are the only ones who can change it, Circuit Judge Galloway has set aside an order of the commmision raising rates of the Western Telephone Company in Woodburn. The decision is based on the home rule amendment of the state laws. The city of Woodburn brought the suit to set aside the order, naming the public service commission and the Western Telephone Company as defendants. The decision affects a question of far-reaching importance, as it was contended, if the Woodburn franchise could be set aside by the commission, without the city's consent, other franchises would not be immune. The old franchise provided that the maximum telephone rates should be not over $1.50 for business service, and correspondingly low rates for residence service. Increases were ordered by the commission on all rates, and the reasons given were that the consolidation of rural lines with the city system gave the people better service, and that the company was not getting adequate returns on its investment. The commission will take the case to the supreme court.

The Coos & Curry Telephone Company has requested permission from the commission to raise the rates on telephones in Coquille and Myrtle Point and has encountered objections in Coquille from the municipal administration. City Attorney J. J. Stanley has given an opinion that the law permitting the public Service Commission to fix such rates is unconstitutional.

NEWS OF CALIFORNIA WATER COMMISSION.

Joseph H. and Laura B. Meredith of Willow Ranch, Modoc county, have applied to the commission for permission to appropriate 115 acre feet per annum of the waters of Bonner Ravine, tributary to Goose Lake in that county, for irrigation purposes. The estimated cost of bringing the water to the land is $1000.

C. J. Laird of Mt. Dome, Siskiyou county, has applied to the commission for permission to appropriate five second feet of the waters of Lower Klamath Lake for irrigation purposes. It is proposed to raise the water 22 ft. by means of a pumping plant and to carry it to 200 acres, at an estimated cost of $4000.

Harry A. Cole of the Hellman Building, Los Angeles, has applied to the commission for permission to appropriate sixty miners' inches of the waters of Antelope Creek in San Bernardino county for mining and milling purposes. By a pipe line half a mile in length, it is proposed to carry the water to the tungsten mines located on the summit of Altura mountain, at an estimated cost of $2000.

E. G. Hopson and A. L. Conrad of Red Bluff, Tehama county, have applied to the commission for permission to appropriate 130 second feet of the waters of Red Bank Creek in that county for use of an irrigation project, which the applicants state it is the intention to form under the laws of the state. In the plan there is proposed a concrete arched masonry dam, 130 ft. high, 400 ft. on top and 60 ft. on bottom, a reservoir to impound 30,000 acre feet, the proposed works to cost in the neighborhood of $400,000. The land intended to be irrigated comprises between 10,000 and 15,000 acres. Six months' time is asked the commission to perfect the plans.

Barclay McCowan of Bakersfield has applied to the commission for permission to appropriate 10,000 second feet of water from the flood waters of Kern River for purposes of irrigation. In his application Mr. McCowan says that he acts as trustee for the people of the county, preceding the formation of an irrigation district under the laws of California. The applicant asks time in which to file maps and other data.

The Guarantee & Investment Company of Hanford, Kings county, has applied to the commission for permission to appropriate 250 second feet of the waters of Cross Creek, tributary to St. Johns and Kaweah rivers, in Kings county, for the purpose of irrigating rice, alfalfa, grain and other crops. The applicants propose a canal five miles long to be known as the Lake Land, Canal & Irrigation Company, for the purpose of irrigating some 4000 acres of land. The estimated cost of the system as outlined is $15,000.

Frank A. Greene, T. P. Ames, S. E. Greene and J. W. Long of Ono, Shasta county, have applied to the commission for permission to appropriate 500 miners' inches of the waters of the Middle Fork of Cottonwood Creek for the purpose of mining and milling gold quartz ore.

Elof Swanson of Alturas has applied to the commission for permission to appropriate 180 acre feet per annum of the waters of the east fork of Rattlesnake Creek, tributary to

Pit River for irrigation purposes. The applicant will require one and one-half miles of pipe to carry the water to 155 acres at an estimated cost of $600.

Abbie L. Andrews has applied to the commission for permission to appropriate three second feet of the waters of Kelsey Creek, tributary to the Santa Maria and Cuyama River in Santa Barbara county. The applicant proposes to divert the water by means of a concrete dam eight feet high, 20 ft. on top and 15 ft. on the bottom, into a ditch one mile long for use in 80 acres. The estimated cost of the work is $1000.

SAN FRANCISCO ELECTRICAL LEAGUE BASEBALL.

The season is now well on its way, after five weeks' play. The teams are all well lined up and have reached the point where good team work is shown, and they are getting down to playing real baseball. The rooters have at last awakened to the fact that the boys are playing "some" ball and have turned out in full force to the last few games, which has undoubtedly helped to make a better showing. Arrangements are now under way for a "cup" to be presented to the winning team at the close of the season. This should create keener competition between the teams and enliven the interest of the rooters. The games of last Saturday, May 20th, were played on the Ocean Shore grounds, at Twelfth and Mission streets.

Ermsco and Pacific States Game.

The game opened with Pacific States at the bat, and they seemed to get the drop on the Ermsco boys right from the jump, landing on them for five hits and three runs in the first inning and for two more runs in their half of the second inning, the Ermsco boys failing to bring in any runs, although getting several men on the bases. In the first of the third inning, Lane of the Pacific States knocked a two-bagger and was scored with a hit made by the next man up, and in the first of the fourth inning, Kennedy of the Pacific States knocked a three-bagger and stole home. The Ermsco boys seemed to be still out of luck, not being able to get a man over the home plate. The fifth inning marked a one, two three put-out for both teams. In the first of the sixth inning the Pacific States managed to get two more men over the rubber, and the Ermsco boys at last succeeded in bringing in a run. In the first of the seventh inning the first three men of the Pacific States were put out, and the Ermsco boys came in for a rally and scored two men, the third man out leaving three men on bases. In the eighth inning neither team were able to get a man to first base. The game was called at this time with a score of 9 to 3 in favor of the Pacific States, who again defended their title of league leaders.

Electric Appliance and Western Electric.

This was a hard-fought battle from start to finish, both teams making several hits and runs in almost every inning. The game started with Western taking a lead of eight runs in the first inning, but after that they were held down to a few runs each inning. The Appliance boys got next to themselves and managed to climb perilously near the Western score, with the result that from the fifth inning on it was a regular swatfest on both sides, both teams running neck and neck and finally ending in the last of the ninth with the score of 15 to 14 in favor of the Westerns.

Standing of the Teams.

	Won.	Lost.	Pct.
Pacific States	5	0	1000
Western Electric	3	1	750
Electric Appliance	1	3	250
General Electric	1	3	250
Ermsco	1	4	200

TRADE NOTES.

The Pacific Electric Manufacturing Company, switchgear builders, formerly located at No. 80 Tehama street, have moved to 827 Folsom street, San Francisco.

The Decker Electrical Construction Company of San Francisco secured a nice contract from the Union Iron Works for their new hospital, amounting to approximately $250,000.

The Indian Electric Works, San Francisco, a new concern, has been the recipient of several good contracts during the past week, one at 128 Third avenue, another at 1463 Post, 1261 Lombard and 928-30 Hampshire street.

The Electric Appliance Company is completing their new demonstration room at San Francisco to be used by the electrical dealers and contractors for their prospects, demonstrating electric specialties. The room is equipped with every detail in illuminating electric appliances.

The California Electric Construction Company of San Francisco installed all the wiring and electric equipment for the German Relief Bazaar at the Civic Auditorium. The electric lighting of many designs with a roof imitating heaven, showing stars, moon, etc., is most effective.

Frank L. A. Graham and Ford W. Harris announce the retirement of F. M. Townsend from patent practice. The dissolution of the firm of Townsend, Graham & Harris, and the formation of the firm of Graham & Harris, patent attorneys, 933 Higgins Building, Second and Main streets, Los Angeles.

G. A. Weeks, manufacturers' agent, formerly in the Pacific Building, has opened up an office and store at 17-19 Main street, San Francisco, renting and repairing motors, with Floyd Seger, under the firm name of the Electric Products Sales Company. They are agents for the Wotton Rexolux and Battery Charging Equipment, also electric trucks that were used at the P. P. I. E. for freight transportation purposes.

The Westinghouse Electric & Manufacturing Company was awarded the contract for 3000 high tension insulators, and the Pierson-Roeding Company was awarded the contract for the same number of high tension pins, to be used on the California-Oregon Power Company's Trinity Center Line. The work on the Klamath River dam has been progressing rapidly, and they expect to have one unit of 10,000 kw. in operation about the first of November.

The Rice Land & Products Company have added a third pumping plant to their Colusa County equipment. This plant consists of a 36 in. Byron-Jackson pump, driven by 100 h.p., 440 volt Westinghouse motor. This pump supplies water to about 2000 acres of newly developed rice land. The total installed capacity on this property amounts to 550 h.p., and the total rice acreage for the season is 5230 acres. These properties are being managed by C. F. Adams, formerly connected with the Pacific Gas & Electric Company. This is the biggest single rice field in California.

The Gamewell Fire Alarm Company has recently installed fire alarm systems at Bremerton, Washington; Baker City, Oregon; Carson City, Nevada, and Auburn, California. The three first had installed the Diaphone compressed air plant, which is automatic, and Auburn has the town bells for public alarm. This company installed six circuit storage battery equipment in addition to their regular system at Ogden, Utah. Salt Lake is adding ten perfect non-interfering and successive fire alarms to their regular fire alarm systems, while the police department is installing 25 flashlights.

The Century Engineering Club, an organization of the employes of the Century Electric Company, St. Louis, Mo., held its second annual banquet and smoker, Tuesday evening, May 2d, at the Mercantile Club. Over 175 plates were reserved for the members and the officers of the company. D. S. Kramer, special representative of the Century Electric Company, the principal speaker of the evening, gave an illustrated talk on his experiences in the various foreign countries which he recently visited. Several musical and vaudeville numbers by members of the organization completed the program.

SALIENT FEATURES OF N. E. L. A. PAPERS.

(Continued from page 417)

the fallacious policy of giving away ranges or selling them at ridiculous prices.

"Publicity" is handled by F. Wardell, who points out the inefficiency of a large amount of advertising material furnished to central stations by manufacturers. The reason for this is analyzed and the following recommendations made: Every manufacturer's advertising department should have a man in the capacity of a printing service expert, who should be on the mailing list of every central station. Working with him should be a staff of copy writers and follow-up service makers, who would make up campaigns. It is good to remember that: (1) The value of an advertising department evidently cannot be measured by the quantity of material it sends out or the number of people it employs. (2) The value of the advertising depends upon the quality and not the quantity of things printed. (3) The value of a manufacturer's advertising material will increase in direct proportion to the number of people who know the men who write it. (4) There should be a clearing house for manufacturers' advertising departments, through which useless advertising may be eliminated. Appended to the report is a very complete and valuable bibliography of merchandising and selling, to March, 1916, arranged under six general and thirty subheadings, compiled from a long list of magazines and other available sources.

Wiring has been divided among several subjects. The standardization of plugs and receptacles has been considerably advanced by most of the manufacturers agreeing to rate receptacles designed for branch or lighting circuits at 660 watts and the 1915 Code has made it clear that more than one such receptacle may be used on lighting circuits. Through the labors of the committee, the plugs and receptacles of many manufacturers are now interchangeable so far as one fitting the other is concerned. Considerable space is devoted to the discussion and illustration of concentric wiring plans and fittings, which have recently been placed on the market. "It is only likely," says the committee, "that this wire may be developed to be as useful for making extensions in office buildings, factories, etc., as for wiring small residences." In regard to the use of solid neutral the committee believes that most inspection authorities will approve the construction with solid neutral when the matter is properly laid before them and that the result will be a distinct saving to the consumer. In regard to the obedience to the Safety Code it is stated that "any electric service is so much safer than the service it replaces that even the most simple electric wiring is usually an improvement." Also that "we should never require wiring to be so expensive that something cheaper and hence more dangerous is used instead." The report touches on the adoption of Cushing's Standard Wiring book, the need of the standardization of screw threads, the advisability of coloring the neutral wire, and the standardizing of the appliance ends of flexible cords and the connection between house wiring and the electric range. The report is profusely illustrated by cuts of fittings and halftones of a number of European and American concentric wire installations.

Electric range committee's report will be published in full in these columns, commencing next week. Further reference apears on editorial page.

The Lamp Committe report points out that the aggregate sales of lamps for domestic purposes, exclusive of miniature, for the year 1915 totaled slightly over 110,000,000, an increase over 1913 of 10 per cent. The average candlepower of lamps sold during 1915 was 42.23, or nearly 2½ times the average candlepower represented by the sales during 1907. Much attention has been given to the improvement of the "focus type," Mazda C lamps, used for footlighting and headlights. Photographic lighting, light projection and lighting outdoor sports at night are discussed. The lumen is recommended as the best unit for rating lamps. A voltage directory of all cities is being prepared by the lamp companies. Member companies should control the lamp situation in their respective communities.

Artificial ice is made either by the simple drop-pipe system with removable cans, cans permanently fastened in tank or the high pressure air system with removable cans. "Taking investment and service into account, the capacity best suited for a 100-ton plant appears to be about 3000 tons general and 200 tons daily capacity." Many data in the form of tables are furnished on "Operating Comparisons" between oil engines, steam engines and central station service, and from the comparisons the latter shows up well. In Chicago there are 18 plants operated entirely by central station service, 17 of these being raw-water and one a distilled-water plant.

Considerable space in the report is devoted to plant operating data, and it is shown that the average kw.-hr. per ton for combined operation was 4.16, and this included lighting and storage refrigeration as well as all ice-making. The average water cost per ton of ice made, exclusive of sweet water for cans, which is 1.55 cents per ton, was .93 cents per ton, and a water loss average for all purposes of 20 cu. ft. to the ton of ice produced. The report concludes with a directory of electrically operated ice plants in the United States, and eleven full-page illustrations of a number of such plants.

Industrial electric heating includes all industrial application of electric energy in which direct conversion into heat energy is the desired result. Its use far exceeds the energy consumed for power purposes. Four companies alone have a total industrial electric heating load of about 70,000 kw., one having a connected load of 20,000 kw. in japanning ovens alone, and another a load of 17,000 kw. in commercial irons. Seven advantages of electric heating are pointed out, namely, that the heat is absolutely independent of temperature; the efficiency of its utilization may be made independent of the temperature at which a process is conducted; it is independent of the atmosphere in which it is generated or applied; it embodies wonderful adaptability; is susceptible of perfect and automatic control; is independent of combustible material and is the most cleanly. Six points on the proper methods of utilization are discussed, and a chapter is devoted to the subject of furnaces for various operations, as well as japanning ovens, core driers, baking ovens and special applications. The author makes the following recommendations: 1—The division of the field along certain easily distinguished lines of demarcation, such as he presents. 2—An appropriation of $2000 annually to defray the expenses in connection with carrying out recommendation. 3—Arrange for the collection and compilation of data applying to industrial electric heating and disseminate such information among the member companies.

The Resistance Heater as a Load Builder, by Edgar F. Collins, deals only with the application of electric heat in industrial processes that require 500 degrees, Fahr., or less. Three types of units are considered, namely, the air heater unit, the cast in or embedded unit, and the immersion type unit. The first is well adapted for room and oven heating in conjunction with automatic controlling devices, the second type for the melting of metal and wax, and the immersion type for the heating of liquids. The report contains numerous illustrations showing commercial applications and summarizes the advantages of electric heat.

Electric furnace installations are increasing, particularly steel furnaces. The continued successful operation of most

of them gives conclusive evidence that the electric steel furnace is a commercially sound proposition. Four sets of tables are presented, showing the status of the art as regards the number and types of furnaces in use at the beginning of 1916 in the United States and Canada. Various tables are given showing the cost of production of the steel by different processes. A rate of 1 cent per kw.-hr. or even somewhat above this figure, is considered satisfactory by the steel people for an ordinary electric steel furnace load, together with the corresponding rolling mill and miscellaneous power load. The demand for power will vary from 200 to 300 kw. per ton capacity of the furnace for the furnace load alone. There are only two electric ferro-manganese furnaces in use in the United States, but these may be taken as a forerunner of the more extended adoption of this method. A chapter is devoted to non-ferrous metal furnaces, electrically heated enameling ovens and forging furnaces, for which there is an enormous field open to manufacturers.

Electric welding is discussed by Sidney R. Dresser from the historical and descriptive standpoint, together with a discussion of the merits of the principal systems in use. A table shows the extent of the field for butt or spot and arc welding, 32 different industries being enumerated. From a central station standpoint spot and butt welders are not a much-to-be-desired load, excepting insofar as they generally are used during daylight hours. The load factor is extremely poor. The situation is considerably better with arc welding, the load factor being about 75 per cent with the carbon electrode process and 50 per cent with the metallic electrode. In the case of resistance welding, on account of the nature of the load, it appears logical to charge a straight demand rate rather than a straight kilowatt hour rate. The author presents in the form of tables data on power costs for spot welders, time of various jobs of arc welding and their cost, cost of repair jobs accomplished by the arc method compared with the costs of the old method, comparative labor costs of blacksmith welded and electric arc welded rings, relative costs and speed of welding steel plate work by electric arc and oxy-acetylene processes, all favorable to the electric processes. In Appendix I the author has compiled information regarding spot welders, in Appendix II actual kilowatt-hour figures and test figures regarding installations in New York City, and in Appendix III a very complete bibliography of electric welding.

The lighting sales bureau presented commercial data on lighting under the following sub-divisions—highway and municipal, industrial and yard, residence, stores and public buildings, electrical advertising, and training salesmen. Abstracts of most of these reports follow:

Municipal and Highway Lighting.—Total revenue has been increased by the introduction of the new lamps. Reduction in cost per unit invariably creates an increased demand for the service. Today the single lamp unit is usually preferred in place of the cluster system. Five methods of evolving and selling street lighting systems are discussed, and their relative merits pointed out. It is shown that in no state is there a legislative act providing for the expenditure of state funds for the lighting of public highways, and there are relatively few instances where highways outside of municipal boundaries are lighted at the expense of counties. Considerable space is devoted to a description of the "Lighting District" method, in vogue very largely in the territory served by the Southern California Edison Company. In the opinion of the committee the subject of lighting of public highways not under municipal control is deserving of the careful attention of the member companies.

Industrial and yard lighting offer a wide field. Details of successful methods of obtaining factory business are given together with a complete discussion of the design of industrial lighting systems, these being illustrated by typical installations. Good lighting increases efficiency, reduces accidents, decreases spoilage, improves output, helps accuracy, betters inspection, reduces eye strain and improves working conditions. Factory lighting straightens the load curve. The new color matching lamps are particularly valuable in many industries. Good lighting methods are also being adopted for railway yards, playgrounds, beaches, building construction, tennis courts, trap shooting and other outdoor sports, police protection, ice cutting, etc. The report concludes with a discussion on legislation and lighting codes.

Store and public building business requires well-trained salesmen to secure it. Contracts for installation should preferably be apportioned among electrical contractors, adding ten per cent to the contract price to cover cost of collecting and handling the account. Advertising effort is most productive in the early spring and fall. A flat rate for window lighting is inadvisable, the installation of a time-clock being suggested. Show-case lighting has been neglected and offers great opportunities as also do interior signs. Churches and buildings under construction are a good field for illuminating sales effort. The lighting salesman, because of his close affiliation with merchants, can do much to instill the necessary "booster" spirit.

Electrical advertising has brought to the central station more new business than was known to have existed. Flood lighting receives considerable attention. "Light seems to produce a pleasing effect on the human race, for we walk along the best lighted streets, we stop in the best lighted stores and amuse ourselves in the best lighted places." Considerable installation and illumination data are given in the report, and several forms of projectors are illustrated. If two projectors, it is stated, are trained on the same area, the intensity will be doubled, if trained side by side, thus keeping the intensity constant, the area lighted will be doubled. The advantages for using the floor lighting projects for billboard lighting are at once apparent, for it can be installed in practically any convenient place; complicated wiring is eliminated, and the working hours for the billboard are greatly increased. Chapters are devoted in the report to flood lighting of public buildings and rifle ranges, its use during construction work, for winter sports and pageants. Considerable space is devoted to the impetus given to the electric sign business in the United States through the introduction of the electric American flag. Chapters are devoted to slogan signs, electric roof signs and factory signs, outlining and outside illumination. The newly developed motograph traveling letter sign is described and highly recommended. The report concludes with the suggestion that the central stations have one or more signs of their own, as it is practically impossible to secure electric advertising unless an example is set by those who will enjoy the most benefit.

Residence lighting with electricity is still lacking in 15,000,000 dwellings in the United States. Details of successful house-wiring campaigns are given, including general and campaign advertising.

The committee summarizes its conclusions as follows:

1. The central station should have a complete analysis of the field.

2. The cost factor should be met by arranging the terms of payment.

3. Central stations should have a satisfactory working plan with contractors who are engaged in wiring.

4. The homeowner's interest must be stimulated to one of monetary desire by adopting campaign methods.

NEWS NOTES

INCORPORATIONS.

LOS ANGELES, CAL.—American Fire Alarm Company has been incorporated with a capital stock of $15,000, by C. A. Wilson, J. M. Marshell, J. L. Trenchard, R. J. Craft et al.

ILLUMINATION.

YUMA, ARIZ.—The Yuma Ice Company is preparing to install an electric light and power system.

SAN GABRIEL, CAL.—The city trustees have awarded a gas franchise to the Los Angeles Gas & Electric Corporation.

LOS ANGELES, CAL.—The board of supervisors will hear a petition on June 5th asking for the formation of the Bonita Meadows Lighting District.

OAKLAND, CAL.—Bids will be received until noon, June 1, by L. W. Cummings, city clerk, for construction of 24 ornamental lighting posts on Grove street.

SAN LUIS OBISPO, CAL.—The Santa Maria Gas & Power Company has begun laying gas mains from the southern border of the city to the Polytechnic school.

EL PASO, TEX.—No further franchises will be granted for the erection of electric light or other wire supporting poles and in future all wires will have to be placed under ground.

HUNTINGTON BEACH, CAL.—The city trustees have ordered the city clerk to advertise for bids for $10,000 of the $20,000 bond issue voted last December for the purpose of installing a municipal gas system.

SAN PEDRO, CAL.—Progress is being made in the movement to secure ornamental lights for Sixth street from Beacon to Pacific avenue. A petition asking for the installation of the system is now in the hands of city officials.

NORTHPORT, WASH.—The council has under consideration a proposal for a municipal light and water system. A Portland company which has had a representative here looking over the ground estimates the cost at $25,000. No definite action has been taken.

OCEANSIDE, CAL.—A deal has been closed whereby the San Diego Consolidated Gas & Electric Company acquires the majority of the stock of the Oceanside Gas & Electric Company, which furnishes light and power for this city and the San Luis Rey Valley.

LOS ANGELES, CAL.—The board of supervisors has authorized the chief mechanical engineer to prepare plans for an ornamental lighting system in the Graham Lighting District. The contract for additional lighting posts in the Westgate Lighting District has been awarded to B. S. McEwan.

LOS ANGELES, CAL.—Plans for the formation of a Peoples Gas Company to take over the holdings of the Southern Counties Gas Company and the gas projects of other public utility corporations in the smaller towns and cities of Southern California have been abandoned, according to an announcement made in San Pedro. The Southern Counties Company will take over the properties of the other and smaller companies issuing stocks and bonds instead of having a new corporation formed.

SALT LAKE CITY, UTAH.—The Utah Gas & Coke Company of Salt Lake City and the Welsbach Street Lighting Company of Chicago propose to make a strong fight to secure a part of the street lighting of Salt Lake City when the present contract with the Utah Power & Light Company expires on December 31, 1816. Heretofore, all of the city street lighting has been done by electricity under contract of the power company. R. W. Bingham of the Welsbach Company is in Salt Lake City and has made a proposition to the city commission to make a sample installation to demonstrate the efficiency of gas for street lighting. The company wishes to secure the contract for the lighting of the northeast bench section of the city with gas.

TRANSMISSION.

IDAHO FALLS, IDAHO.—N. M. Holm, manager of the Ashton & St. Anthony Power Company, has made application for a franchise to furnish electric power for heating purposes at Ashton.

KLAMATH FALLS, ORE.—Project Manager J. G. Camp of the reclamation service, in behalf of the Klamath Water Users' Association, has asked for a franchise for a high power line through Klamath Falls.

GRASS VALLEY, CAL.—Work has started on a new power line to supply electric current for the plant at the Allison Ranch mine, which will be reopened by the Grass Valley Consolidated Mine Company.

PROSSER, WASH.—The Grandview Irrigation District has made application for a franchise for the construction of an electric transmission line on the road running east and west through section 30, township 9 north.

PLACERVILLE, CAL.—The Pacific Gas & Electric Company has begun a suit in the superior court for the condemnation of land in this county which the company desires for right of way for an electric transmission line. The company is building an electric transmission line from Nevada to San Joaquin county.

VENTURA, CAL.—The Ventura County Power Company was the only bidder for a franchise for conveying power over the county. Permision is given to construct pole lines in various parts of the county outside incorporated cities. The entire county is covered except the Ojai Valley now served by a local corporation.

YREKA, CAL.—The California-Oregon Power Company has preparations under way for the building of a power line from Casella to Weaverville. Superintendent O. G. Steel has left for Carville to install a temporary electric power plant, for a large dredger at that place, pending the entry of the company's high power line. A surveying party will start work on the line from Castella under the direction of Howard O'Connor, the power company's engineer at Yreka.

LOS ANGELES, CAL.—Negotiations looking toward the city's purchasing the private distribution systems of the three power companies are to be entered into at once by the city and the companies. The board of public service commission has authorized plans drawn for a shop building to be constructed in connection with the central distributing tation and for a substation to be installed in the Garvanza district.

TELEPHONE AND TELEGRAPH.

OAKDALE, CAL—The field committee of the Oakdale Irrigation District has been instructed to investigate the cost of extending the telephone system at Lone Tree.

SAN MATEO, CAL.—The Pacific Telephone & Telegraph Company has purchased a lot in Hillsborough and soon will start construction of a building to house its peninsula officials

WINTERS, CAL.—The Pacific Telephone and Telegraph Company will begin work in about a month rebuilding its line between Winters and Monticelo. The work will cost about $5000.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 American Ever-Ready Works of National Carbon Co.. Los Angeles; 755 Folsom St., San Francisco; Seattle.

A-2 Atchison, Topeka & Santa Fe Railway Co..... 673 Market St., San Francisco; 1218 Broadway, Oakland.

P 1 Baker-Joslyn Company..... 3
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

B-2 Benjamin Electric Manufacturing Co..... 590 Howard St., San Francisco.

B-5 Bridgeport Brass Co..... 3
(See Pierson, Roeding & Co.)

C-1 Century Electric Co..... 14
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 Crocker-Wheeler Co..... 5
Crossley Bldg., 618 Mission St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 Cutler-Hammer Manufacturing Co..... 11
579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 Davis Slate & Manufacturing Co..... Chicago, Ill.

D-2 Dearborn Drug and Chemical Works..... 13
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-7 Economy Fuse & Mfg. Co..... Kinzie and Orleans Sts., Chicago.

E-1 Edison Lamp Works of General Electric Co..... Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 Edison Storage Battery Supply Co..... 13
441 Golden Gate Ave., San Francisco.

E-3 Electric Agencies Co..... 247 Minna Street, San Francisco; Central Building, Los Angeles.

E-6 Electric Novelty Works..... 533 Mission St., San Francisco.

E-4 Electric Storage Battery Co..... 3
743 Rialto Bldg., San Francisco.

E-5 Electric, Railway & Manufacturing Supply Co..... 13
34 Second St., San Francisco.

F-1 Fairbanks, Morse & Co..... Los Angeles; Portland; 651 Mission St., San Francisco; Seattle; Spokane.

F-3 Federal Sign System (Electric)..... 10
618 Mission St., San Francisco.

G-1 General Electric Co..... 12
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

G-1 General Vehicle Co..... 1117 Van Ness Ave., San Francisco; 331 Wall St., Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C.

H-1 Habirshaw Wire Co..... (See Western Electric Company.)

H-2 Hemingray Glass Co..... 4
236-240 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-5 Hunt, Mirk & Co..... 141 Second St., San Francisco.

H-7 Hurley Machine Co..... 2
New York and Chicago. (See Pacific States Electric Co.

I-2 Illinois Electric Co..... 261-263 So. Los Angeles St., Los Angeles.

I-3 Interstate Electric Novelty Co..... 111 New Montgomery St., San Francisco.

L-1 Leahy Manufacturing Co..... 4
Eighth and Alameda St., Los Angeles.

L-2 Locke Insulator Manufacturing Co..... 4
(See Pierson, Roeding & Co.)

M-2 McGlauflin Manufacturing Co..... 4
Sunnyvale, Cal.

M-4 Morse Chain Company..... Monadnock Bldg., San Francisco.

M-3 Moore & Co., Charles C..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland, Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 Nason & Co., R. N..... 151 Potrero Ave., San Francisco.

N-6 National Carbon Company..... Cleveland, Ohio.

N-2 National Conduit & Cable Co., The..... Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 National Lamp Works of G. E. Co..... 14
(All Jobbers.)

N-4 New York Insulated Wire Co..... 629 Howard St., San Francisco.

N-5 Northwestern Pacific Railroad..... 808 Phelan Bldg., San Francisco.

O-1 Okonite Co. (The)..... 14
(All Jobbers.)

P-1 Pacific Electric Manufacturing Co..... 80 Tehama St., San Francisco.

P-2 Pacific States Electric Co..... 2
236-240 So. Los Angeles St., Los Angeles; 61-67 Fifth St. No., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 Pelton Water Wheel Co..... 4
2219 Harrison St., San Francisco.

P-5 Pierson, Roeding & Co..... 4
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-6 Pittsburgh Electric Specialties Company..... 202 Aronson Bldg., San Francisco.

P-7 Pittsburgh Piping & Equipment Co..... 14
Monadnock Bldg., San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The..... 211 J St., Sacramento; 356 Market St., San Francisco.

S-4 Southern Pacific Co..... 4
Flood Bldg., San Francisco.

S-5 Sprague Electric Works..... 4
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 Standard Underground Cable Co..... First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash.

T-1 Thomas & Co., R..... Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives.

T-2 Tubular Woven Fabric Company..... Pawtucket, R I.

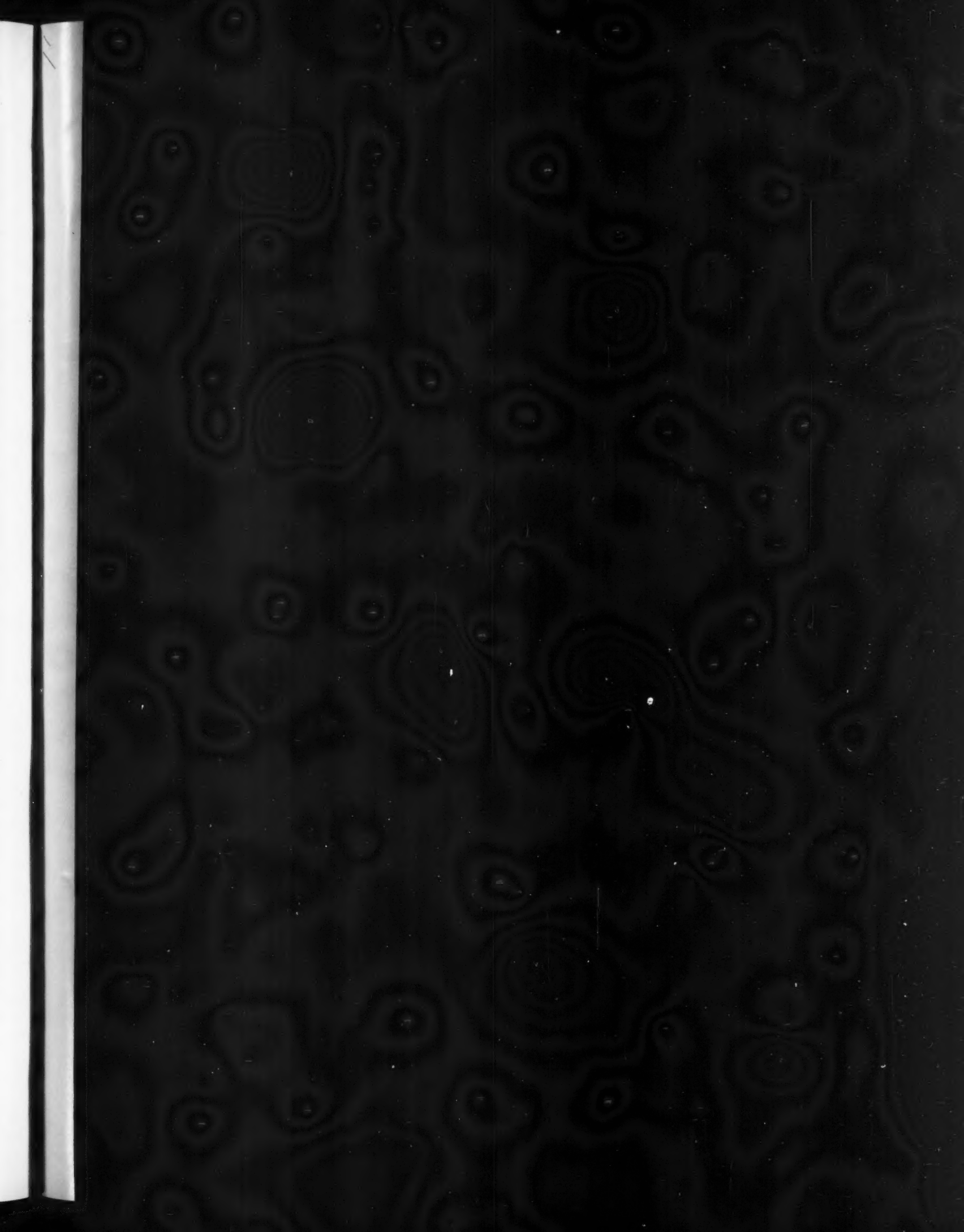
U-1 Union Sheet Metal Works..... 575 Howard St., San Francisco.

W-1 Wagner Electric Manufacturing Company..... 3
St. Louis, Mo.

W-2 Western Electric Co..... 5
Eighth and Santee Sts., Los Angeles; 1901 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-4 Westinghouse Electric and Manufacturing Co..... 6
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second St., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-5 Westinghouse Machine Co..... 141 Second St., San Francisco.

W-6 Westinghouse Lamp Co..... (See Westinghouse Electric & Manufacturing Co.)

W-8 Western Pipe & Steel Co..... 444 Market St., San Francisco; 1758 North Broadway, Los Angeles.